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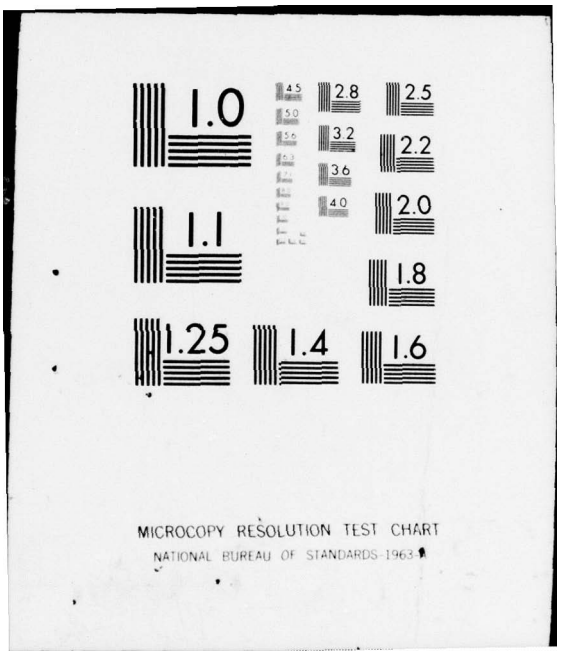
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ANTISUBMARINE WARFARE: HISTORICAL AND PROSPECTIVE CONSIDERATIONS

[Lieutenant Commander Didier Brenot, Défense Nationale, June 1977, pp 55-70; French]

The 22nd session of the Assembly of the Western European Union was scheduled to discuss, on 2 December 1976, a report which Mr. Roper, British MP, presented on ASW in the name of the Defense and Armaments Committee. This report is /55*
interesting for several reasons because, after describing the Soviet capability in this area, it analyzed the West's vulnerability, presented NATO resources in research, detection, and weapons systems and evaluated the ASW capability of the Allies. It concluded that it was necessary for the Allies to coordinate their tactics, to step up their research efforts, and to assure the interoperability of their forces in this field.

Nevertheless, this report's recommendations are subject to discussion. They, in effect, invite the Europeans to employ their resources for ASW missions primarily in coastal waters and at the approaches to ports, in other words, zones which, as the report underscores, are more suitable hunting grounds for enemy submarines going after merchant vessels. The United States would handle oceanic waters. France--which has worldwide interests and whose sea-lanes largely run through the area covered by the Atlantic Alliance--obviously cannot be satisfied with this kind of delimitation of authority.

Having stated this reservation, it is, however, still true that Mr. Roper's report merits particular attention; We thought that it might be interesting for our readers to have a specialist on this subject--currently on duty with /56
the "Materiel" division of the [French] Navy Staff--to comment for them on this report and to review for them the

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*Numbers in the right margin indicate pagination in the original text.

essential aspects of what we must know about this type of warfare--already being conducted in peacetime--and its foreseeable evolution.

In the still rather recent past, world history was blended into the history of Europe which, in turn, was identified with Christianity from the 14th to the 20th century. It was, however, a divided Europe where several powers--Spain, Holland, Great Britain, France, and then Germany--faced each other; it was a compact area where religious wars and then various forms of nationalism developed. The outside world was divided among the European empires and went along with the activities of the various home countries. Strategy was confined to European theaters. Upon further analysis, going beyond a listing of historical events, we always come back to the scheme that was so dear to Admiral Castex, the scheme of a coalition led by the Maritime Power, "the immense little island, the nightmare of Napoleonic strategy," against the Continental Alliance. In that Europe, France was always with the Continental Alliance.

Our spirits, sustained by this history in which we played a fine role, are finding it difficult to discern the strategic change in Free Europe where we live and which was left to us by the Yalta agreements. Our Europe--which continues to entertain its illusion with 1/10 of the population and 1/3 of the world's income--must be viewed above all in terms of the tremendous cultural attraction which it continues to exercise upon the entire world, although it has shrunk physically, accounting for only 3.5% of the planet's surface. The world's center of gravity is no longer here. Today, the United States is the insular and maritime power; the Soviet Union is the continental power. We belong to that fringe which is the traditional buffer between empires. Western Europe is to America what, to Great Britain, was the fortified field of Torres Vedras in Portugal against Napoleonic Europe.

A continental bridgehead for American strategy, isolated from the continent as a result of the closing of the borders to the East, Western Europe is from all standpoints in an insular situation. As such, its survival, both political and economic, is possible only on the dual condition that it keep its territorial sanctuary beyond reach and that it it safeguard its freedom of communication with overseas countries.

In French defense organization, protection of the national sanctuary is guaranteed by our nuclear deterrence establishment, and the essence of our defense effort is designed to keep our strategic nuclear forces up to their required level and to protect them; the essential component of those strategic nuclear forces is represented by the SSBNs. We must, furthermore, think of keeping our lines of communication open; they are threatened essentially, over their entire distance, by nuclear attack submarines. /57

Everybody knows or everybody can see for himself what an important role the submarine plays; it is the preferred instrument of nuclear deterrence or manifold menace and it is present everywhere along our lines of communication. During its 22nd session in 1976, the assembly of the WEU heard a report authored by the British MP, Mr. Roper, on ASW. With the help of this report, we propose, in the following, after analyzing Western Europe's maritime forces and vulnerabilities, to examine the characteristics of ASW and the development of resources with a view to guaranteeing the safety of our SSBNs so as to assure the defense of our lines of communication.

Summary of Report to WEU

In his report to the 22nd session of the WEU Assembly* on ASW,

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*Document No. 725, WEU, dated 29 November 1976

Mr. Roper presents the following analysis: "The Atlantic is the world's most active ocean. Total traffic between Europe and America annually comes to 1.6 billion t. Every day there are 7,000 merchant vessels in transit or in the ports of NATO; during periods of crisis it is necessary to keep this traffic volume at half its normal level; in other words, about 70 million t per month. Moreover, it would be necessary to ship the reinforcements destined for SACEUR*, in other words, for

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*Supreme Allied Commander in Europe (of the NATO forces)

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an armed conflict, about one million men during the first month, plus one million t of materiel. Ammunition would account for an additional 4.5 million t to which we would have to add 4.5 million t of initial supply shipments. Fuel supplies have been estimated at 600,000 barrels per day.

"It would be possible to transport the men and their light equipment by air; the rest would require 1,000 cargoes, in other words, about 500 monthly support shipments. /58

"According to the 1975-1976 German Defense White Book, petroleum supplies being moved across the Atlantic Ocean came to 651 million t in 1974, including 512 from the Middle East, after going around South Africa. Moreover, about 140 million t came across the Mediterranean. According to the most moderate estimates of civilian requirements, it is believed that Western Europe could remain autonomous in food supplies, iron, and steel, provided it can keep its communications open along its coastal waters."

Submarines constitute an even graver threat than surface units as far as maritime communications in the North Atlantic are concerned:

"It is estimated that 100 out of 320 Soviet operational submarines would be deployed in the Atlantic from the start of hostilities. Moreover, the powerful Soviet Navy would offer the USSR other possibilities more worthwhile than the triggering of a general war in Europe. The NATO zone is bordered on the south by the Tropic of Cancer. Beyond that, according to Admiral Gorshkov, there are other zones which are as important to NATO. The Soviet nuclear submarine fleet could attack and sink vessels in the South Atlantic and in the Indian Ocean and even beyond. Without undertaking military operations in the NATO zone the Soviet Union could considerably reduce the petroleum supply of the NATO countries (...). The only thing that SACLANT* can do at this time

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*Supreme Allied Commander Atlantic

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is to perfect emergency plans for the protection of shipping in the South Atlantic and the Indian Ocean. Naturally, SACLANT could not carry out these plans nor deploy any forces without the express authorization of the Defense Plans Committee..."

"If we consider the Soviet submarine forces which are in the Atlantic during a 'typical' day and which could constitute the nucleus of forces permanently maintained on advanced deployment, we would have between 3 and 5 strategic submarines and between 1 and 3 missile-firing submarines, cruising. Locking at the estimates which call for 100 submarines in the Atlantic from the start of a conflict, it is evident that such a tremendous boost would imply a certain period of alert because, out of the approximately 90 supplementary submarines, a certain number would very probably be detected the moment they entered the Atlantic." /59

The geography, as a matter of fact, is very favorable to NATO. "All NATO maritime countries have direct access to the high seas.

"The Warsaw Pact countries are in a very different position. In case of conflict, the outlets from the Black Sea and the Baltic Sea could very probably be blocked as long as the contiguous NATO territory remains in the hands of the Allies. The Soviet Northern Fleet, operating from Kola Peninsula, is forced to go through the passages between the various territories of NATO countries before being able to reach Bear Island and North Cape are, respectively, 110 and 230 nm wide. At the outlet from the Sea of Norway, the passageways are 150 nm between Greenland and Iceland; 220 between Iceland and Faero and 150 between Faero and [the] Shetland [Islands]; 150 between Shetland and Norway.

"Because of the very many listening devices placed on ocean bottoms and the use of maritime patrol aircraft from contiguous territories, the NATO ASW forces have an important potential, making it possible to detect the passage of a large portion of the Soviet submarines.

"The strategic submarines of the NATO member countries have an operations zone which, starting from the southern tip of Greenland, runs through the northeastern Atlantic down to Gibraltar and encompasses the entire Mediterranean.

"American submarines are probably patrolling the Pacific Ocean and will do so increasingly when the Trident submarines go on station. In view of the vastness of these oceanic zones and their great depths, there is little likelihood that the USSR would be able to deploy ASW resources capable of destroying even a small proportion of allied strategic submarines. One possible tactic would be to have all of the submarines on patrol "tailed" by nuclear attack submarines; but that would require a number of submarines of that type that would be considerably greater than the number of allied strategic submarines. /60
The USSR is presently operating 32 SNAs [nuclear attack submarines] against the 50 allied SSBNs. There is, therefore, little probability that it would have the necessary 'tailing' potential."

In this study, the reporter of the WEU Defense and Armaments Committee emphasizes the decisive advantages of the Western Powers, both in terms of the deployment of their SSBNs and for ASW surveillance of the oceans. But he also shows to what point Western Europe depends on maritime trade in peacetime and even more so during times of crisis. We can, moreover, see the risks incurred by our commerce due to the fact that Soviet SNAs* are covered by the North Atlantic Treaty only in

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*Nuclear attack submarines; their propulsion is nuclear; their mission is to attack nuclear missile-firing submarines and also surface vessels.

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the Atlantic and north of the Tropic of Cancer. Beyond that there is no organization in place.

To the potential threat against our lines of communication from Soviet submarine forces we must, for good measure, add the hypothetical threat of the rising navies of the new countries. The proliferation of the submarine arm is a fact of our contemporary world. These are only conventionally-powered submarines but several navies have already decided to obtain them, enticed by the always interesting relationship between the "simplicity" of the arm and its extraordinary offensive effectiveness; India and Egypt have submarines of Soviet origin. Pakistan and South Africa have French submarines. The countries of Latin America and Iran are equipped by the United States, Germany, or Great Britain.

Some Technical and Kinetic Characteristics of ASW

The Marine Environment

In trying to describe our planet, the astronauts dubbed it "the blue planet." The ocean covers 7/10 of the globe's surface and the sky is reflected in its waters. Beyond words, beyond the poetic meaning, the expression covers a certain number of facts familiar to the sailor although we must always remember them. The electromagnetic radiation which makes up light undergoes total reflection by the dioptric water-air system. This radiation does not penetrate into the marine environment and, viewed from space, the earth is rather similar to our classroom globes, that is to say, the land is green and brownish, abundantly marked by relief, climate, and human life; the oceans are blue, deserted, and impenetrable. /61

We can say without exaggeration that the hidden face of the moon, of which we have some photographs, is better known to us than the oceanic environment. The dioptric water-air system blocks the passage of all radiation. The marine environment itself opposes human penetration and the propagation of electromagnetic waves. You go several tens of meters down and all is darkness--darkness, but not silence.

Sound is the only information vehicle capable of moving in water over sufficient distances. Unfortunately, even for sound, the ocean is far from an ideal propagation environment. It is a limited, non-isotropic, non-homogeneous environment, more fluctuating with the seasons and the weather. Sound energy is reflected by the bottom and the surface and it is absorbed and diffused. Its speed above all is modified here permanently. We understand the importance assigned by the big navies for the past 20 years to the field of oceanography. The Soviet effort in this field is considerable, very much greater even than the American effort.

Sound itself is a rather inconvient vehicle. It is slow. Its average speed in water is 1,500 m/sec. This leads to a series of consequences: the information that is moved along is quite rare and we must get the most out of a sample; it is rather old because, when detected by echo, a target 15,000 m away is not discovered until 20 seconds later.

And here is another point worth mentioning: sound energy is absorbed faster as the frequency used goes up. In echo detection, the degree of accuracy with which we describe a target is a direct function of the frequency used. We must, therefore, find a compromise between the detection range and the definition degree desired. An "optical" definition is possible only a few meters away. The silhouette of objects can be analyzed up to several tens of meters. Beyond that, one can only hope for an indication of presence and speed.

We must also have a clear understanding of what we mean by "indication of presence." Precise localization, permitting the use of a weapon, is possible with the help of active sonar (echo detection). But the ranges of these sonars are necessarily limited; moreover, these ranges are rather uncertain because they are subject to the whims of sound propagation in a marine environment. The most powerful sonars available today have average ranges of several tens of kilometers but with a standard deviation of the same order of magnitude. /62

Several solutions are possible to reduce this standard deviation: hull sonars, exploiting the convergence zones or using the reflection of sound waves on the bottom such as the American AN/SQA 26; towed sonar, tending to be independent of the disturbed propagation conditions in the vicinity of the surface, such as the French DUBV 43. There is only one solution that makes it possible to get reliable and guaranteed performances; it consists in exploiting the "reliable"acoustic channel". For this purpose it is necessary to use a sonar at a depth of several thousand meters, something which cannot be done without difficulty in terms of manufacturing technology and employment tactics. This is the way currently being explored in France through the Cormoran project.

Passive sonars (listening for acoustic discipline breaches) make it possible to monitor larger areas; they give us a good indication of bearing, but determining range requires the cross-checking of several measurements. The radius of probability is always large and becomes greater as the target is more distant and better concealed. It always takes a lot of time to reduce its dimensions to the point where one can bring a weapon to bear.

These characteristics of the marine environment and of sonars constitute the foundation for the success of the underwater vehicle, its reputation for invulnerability.

The Submarine

Submarines during the last two world wars were a rather rudimentary weapons system; navigating and fighting on the surface, the submarine could hide at a rather shallow depth only. It was a kind of gunboat, an original torpedo boat whose means of observation were those of the surface vessel, that is to say, line of sight.

On 9 January 1917, Kaiser Wilhelm II decided to launch unrestricted submarine warfare as of 1 February, in spite of the imminent risk of a break with America. The total monthly losses of the Allies immediately went up and in April reached the frightening figure of 874,576 tons. We must read the memoirs of Jean Monnet to measure the degree of concern at that time; France and Great Britain were almost strangled and had only a few days of reserve stockpiles left. What was needed was a tremendous breakthrough by the Allies, the entry of the United States into the war in April, a coordinated defensive reaction, /63

a powerful offensive against the submarines, the colossal speedup of the ship building rate so that the monthly loss curve would, with its ups and downs, finally reveal a constantly declining average: October, 1917, 445,096 tons; January, 1918, 304,427 tons; April, 1918, 278,804 tons. The German goal of 600,000 tons for 5 months was not attained. The logistics and statistical war turned to the advantage of the allies--but at what price!

History repeated itself in 1942. Admiral Doenitz's submarines attacked the North Atlantic convoys in packs. "Rudeltaktik" [wolf-pack tactic] involved sneaking up on the convoy, launching a surface attack at night and then hiding with the help of the confusion caused in the convoy. The Germans furtunately concentrated their attacks on cargo vessels, neglecting their escort vessels. It was necessary to combine the employment of escort vessels and radar-equipped aircraft, to cover the skies to the very center of the Atlantic in order to drive the submarine from the surface and force it to operate underwater. After that, submarine progress was constant and prodigious. Today, thanks to nuclear propulsion, the submarine has a practically unlimited action radius, without any restrictions on speed, while remaining completely submerged. With the adaptation of ballistic or aero-dynamic missiles, the variety of its missions was greatly increased. To the submarine's traditional missions of blockading the coast and attacking maritime communications lines--which were in keeping with the diesel submarine's low speed and rather low endurance--we must, today, add the strategic bombing missions of the guided missile nuclear submarine and the force harassing missions which can be assigned to the nuclear attack submarines.

But this champion retains its weaknesses, some of them congenital. Deprived of direct sight, the submarine was equipped with increasingly high-performance passive sonars, capable of firing on the basis of noises and acoustic signals emitted by merchant vessels in transit or surface forces. But that is not enough. The submarine is blind and must figure out its tactical situation on the basis of fragmentary /64 information. It thus measures bearings, threat levels, and more rarely, ranges. The data must be patiently cross checked, confirmed, and then interpreted: discrimination of moving objects, assessment of their movements, classification, identification, etc.

The submarine encounters these difficulties during each phase of the engagement process, that is to say, from initial detection onward, during the interception maneuver and when firing its weapons. It takes long minutes of analysis to figure out what is going on; data synthesis, most often a delicate matter, is always subject to caution. This blindness to which we must add great difficulty in communicating while remaining undetected, turns the modern submarine into a solitary fighting unit. Moreover, its need for security in coping with risks of interference with friendly forces obligates the submarine to adopt strict rules of distribution in terms of space and time. The submarine is a space eater. Offensive submarine deployments are necessarily wide-meshed.

ASW Resources

The submarine itself is a good ASW platform. Most of the attack submarines are equipped to carry out this assignment under the best possible conditions. But we can see clearly that the information collection difficulties are even more acute when the adversary, too, is a silent submarine. One must be able to get information from the slightest breach of security, most often a change in speed or rarely a sonar emission. The engagement process itself is much more complex. The slightest estimation error can alert the adversary and can lead to loss of advantage.

The maximum speed of surface vessels has leveled off around 30 kn very logically for cost reasons and also for reasons of detection capability: the noise masks the sound signals that are processed by the sonars; noise also constitutes a security breach which is useful to the submarine because it is thus alerted. Due to the tight budget situation and the high unit cost, the number of ASW vessels is still limited. It even tends to decrease steadily in the case of large- /65
tonnage vessels. The range of the ASW weapons systems of these vessels remains essentially confined to the target detection and localization range.

The maritime patrol aircraft, in turn, the big victor in the Battle of the Atlantic during the forties, still exerts strong pressure on submarine forces but its chances of engaging an attack submarine are very poor. Its radar is no longer the principal means of surveillance. Information reaches it from a network of buoys operated by radio; with their help, it listens to the sound emitted by the submarine. The disappearance of the submarine into the depths has turned the aircraft into a blind instrument whose information sources are as difficult to operate as those of the submarine. This, moreover, involves very expensive equipment and, here again, the number of aircraft remains limited.

While hovering, helicopters can use a dipping sonar but the limited dimensions of the equipment enable us to expect no more than a rough localization capability (several thousand meters) and a rough classification capability. Their role in ASW is essentially a supporting role for information collection and for firing weapons.

After World War II, the United States developed fixed passive sonar systems using the sound emissions of submarines. These systems permit direction measurements as well as an analysis of the noise frequency received which, in certain cases, constitutes real signatures, making it possible to identify the noise maker. The ASW report by the WEU mentions the best-known of these systems, the SOSUS system placed in service during the early sixties: "The SOSUS system employs vast hydrophone networks placed on the ocean bottom and linked by cable to the coast where the signals received are processed and analyzed by computer. The maximum range of this complex system is said to be on the order of 1,000 nm; 21 SOSUS stations were operational in 1971, distributed among a certain number of integrated installations with such code names as 'Caesar,' 'Colossus,' 'Barrier,' and 'Bronco.' The latter two installations

were situated on the territories of allied countries, and we know that the United States transferred the direction of one SOSUS station to Canada. It is felt that the SOSUS is an effective system capable of identifying and localizing nuclear submarines at great distances, except in shallow zones. According to a United States Secretary of Defense report for /66
1977, the SOSUS has been in the process of reorganization and revision since 1972; entirely new detectors should improve its effectiveness. Parallel to that, the SURTASS--towed detector surveillance system--is in the final production stage; it is a mobile version of the SOSUS. The effectiveness of all passive systems will be reduced if it should turn out to be possible to reduce the noise made by submarines."

The WEU report also alluded to the American SEAGUARD project already described in the technical press (Sea Technology, November, 1974, November 1975, November, 1976); the American budget this year allocated $12 million to that project. This involves the integration of the collection and real-time processing of all data for an ocean basin involved in ASW, furnished by the US Navy and the Air Force. The purpose is to detect a possible increase in strength of the enemy submarine deployment. This calls for the use of a considerable computer capability and the intensive employment of communications satellites.

It is, as a matter of fact, necessary to be able to differentiate the noises of some submarines on patrol from those emitted by surface vessels. Now, there are about 3,000 cargo vessels in transit on the North Atlantic every day, plus 6 to 8 Soviet nuclear submarines! Such an undertaking is beyond any European nation. Moreover, it is intended to capitalize on the noise discipline breaches of the submarines.

There is no doubt that great progress will be made in acoustic security for nuclear submarines during the next decade, for example, by reducing the emitted noises, by simulating these noises in order to mask any possible signature or to imitate that of other, more inoffensive moving objects. One can also visualize countermeasure systems intended to defeat the surveillance networks. And we are not even talking here about the consequences of the increase in maritime traffic. The present American effort connected with the SEAGUARD project should normally mark the advent of acoustic warfare in the oceans and particularly in the North Atlantic.

This brief review essentially demonstrates an uneven evolution between the performance of the submarine and the performance of the ASW systems. Even in long-range terms, we cannot see how that imbalance can be modified. This moves us to find ways to counter the underwater threat by nonconventional means.

Future Prospects

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The ambitious and colossal SEAGUARD project--which is a part of the United States defense system--is an original solution. It makes possible the surveillance of some oceanic zones that are crucial for the Americans;

but it does so only for a few years; passive listening systems are easy to deceive and to defeat. This surveillance will sometimes result in a precise tracking of noisy submarines. It is more likely aimed at a global and constant evaluation of the submarine threat and its variations. The Americans have invested considerable sums of money in their ocean bottom surveillance systems and would rather welcome a situation in which the other NATO members would concentrate their efforts in the ASW area on coastal defense and on the point defense of certain targets (choke points of maritime traffic, naval forces, precious convoys). The WEU ASW report states its conclusions quite frankly: "The committee believes that financial considerations are sufficient to persuade most of the NATO countries to concentrate their ASW efforts on coastal defense and point defense. Such specialization naturally will not mean the end of joint operations with Canadian and American ASW forces. 'Point defense' includes the capability to protect convoys and naval forces."

This complementarity of efforts desired by the United States is logical. The members of the Atlantic Alliance naturally contribute their efforts to safeguarding the national sanctuary and to the maintenance of the lines of communication of the American maritime power. But the European nations have a right to consider that the risks incurred by their maritime commerce are not all covered by the Atlantic Alliance. Beyond the North Atlantic and the Tropic of Cancer, there is an underwater threat to our petroleum supply. The route around the Cape of Good Hope is vital for Western Europe, but it is not for the United States.

Original solutions can be developed by remaining on a European scale. Encouraging directions are emerging in the development of ASW weapons systems themselves and in the evolution of tactics.

Let us consider the principal factors in weapons systems. First of all, there is the maximum effective range, that is to say, the smaller of the following two ranges: maximum detection-classification range and maximum range of delivery vehicle carrying the payload.

ASW Performance Development

Submarine: parameters	World War II	1980-1985 Projection	Multi-plication Factor	Remarks
Maximum speed (submerged)	6-8 kn	Conventional sub: 20-25 kn Nuclear sub: 25-30 kn Fast nuclear sub: 40-50 kn	3 5	No significant progress for escort vessel before 1990 (surface-effect and hydrofoil vessels)
Endurance when submerged	Several hours	Two months or more	200 to 300	
Intercept/ localization range	Several km	50-100 km (variable; very uncertain)	10 to 20	For escort vessel: current major progress in active sonars (several tens of km); adaptation of passive sonars to surface vessels
Range of weapons	Several km (torpedoes)	Wire-guided torpedo, 20 km Missile, 40 km Antiforce missile, 400km	5 10 100	For the escort vessel, current technology offers all possibilities of exploiting detection ranges
Maximum depth	200 m	300 to 600 m	3	
Payload power	250 kg TNT	Nuclear warhead	10^6	
Number of submarines	1939: 57 German submarines	1976: 308 Soviet submarines, including 144 nuclear subs; about a score of submarines belonging to "other" countries		Number of escort vessels, limited by unit cost, tends to decrease, at least in high-performance classes

This maximum effective range is being increased quite considerably. /69
The choice of optimum antenna depth, the improvement of signal and data processing, the combination of data coming from various sensors--these increasingly making it possible to fire a weapon at the same time as the attacking submarine.

The next factor is the time required to hit the target. The corresponding parameters consist of the decision-making speed, the weapons firing speed, and the duration of the delivery vehicle's flight. Each of these parameters is being improved, especially the decision-making speed, with the help of considerable computer equipment.

We must next achieve a high hit probability, that is to say, we must make progress in terms of quality with regard to initial localization, relocalization, and final weapons guidance. Finally, we must have good enemy target knockout probability with the help of powerful warheads and this, of course, means that the weapon itself must function reliably.

It is, furthermore, not necessary to make the same financial effort for all of these weapons systems factors. For example, one can logically think of saving money on precision in target localization and weapons guidance if we adopt a big payload.

The tactical action itself can be improved. In the face of the underwater threat and in a defensive situation, naval air units will find their best chances of success by using methods aimed at even further complicating the submarine's analysis task by presenting it with as fluid a tactical situation as possible, which, in turn, will force the submarine to risk acoustic, electromagnetic, or visual security breaches.

Protection of lines of communication--so far, provided by the convoy technique--will have to be developed. The number of vessels to be protected will hereafter be too great, considering available escort vessels. It will be ten times greater if we consider only traffic in the North Atlantic, because current NATO resources permit effective escort only for a flow of 300 vessels per day. The only economical solution in terms of escort vessels would be to fall back on the technique of patrolled routes, for certain sea-lanes or portions of heavily frequented and dangerous sea-lanes. This technique, which has always been frustrated by submarines in the past, today has more chance of success to the extent that the average range of ASW systems ceases to be too uncertain. From this viewpoint, the assignment of ASW patrol craft, soon to come, using towed or dipping sonars with a reliable acoustic /70
channel capability, constitutes decisive progress because CAS detection-classification ranges of sonars with that capability are guaranteed and are no longer unreliable.

In all cases it appears indispensable to get the most out of the combined employment of the various ASW resources.

Conclusion

The report presented by Mr. Roper to the 22nd session of the WEU Assembly of ASW in 1976 emphasizes the crucial importance of ASW to the Atlantic Alliance. We hope that we have shown, furthermore, that beyond the zones covered by the North Atlantic Treaty, certain of our lines of communication--vital for France and for all countries in Western Europe--are henceforth under the threat of attack submarines.

Our situation analysis tends to show that the general evolution appears to present no great hopes for the ASW forces if, under the pressure of events, we confine ourselves to improving the existing means and tactics, even at great cost. However, it is under this aspect of unwillingness that the present lines of conduct of Western European countries appear.

We think that we have above all evidenced a certain number of factors capable of reversing the fighting conditions over the next decades in favor of the ASW forces, such as great detection-classification ranges; powerful shipboard computer equipment; better adaptation of platforms to specific tasks; recourse to tactics combining these technical factors in the best possible way and constantly seeking to achieve the element of surprise, deception, and ruse. The attack submarine is a redoubtable but lonely adversary. We must send out against it all possible and *imaginable* forces to wear it down, to saturate its intelligence.

That presupposes, first of all, an awareness of the situation as a whole and then a determination to respond to the challenge as completely as possible. ASW could be one of the first tasks to be assigned to the maritime forces of the European nations on a joint basis.