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THE OCEANS, AIR, AND SPACE BETWEEN THE NORTH ATLANTIC PARTNERS

by

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prepared for

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March 1985

THE OCEANS, AIR, AND SPACE BETWEEN THE NORTH ATLANTIC PARTNERS

The Geographical Imperatives

Sea Lines of Communication between North America and Western Europe

Sea-based Strategic Nuclear Deterrence

Air Lines of Communication between North America and Western Europe

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Land-based Intercontinental Nuclear Deterrence

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THE OCEANS, AIR, AND SPACE BETWEEN THE NORTH ATLANTIC PARTNERS

THE GEOGRAPHICAL IMPERATIVES

Twelve members of the North Atlantic Alliance and all members of the Warsaw Treaty Organization occupy contiguous territory covering most of Western Europe. But the other four NATO members are separated from their twelve partners by water, and by considerable distances as measured through air and space.

The separations place the United States, by far the most powerful member and the primary supplier of strategic manufactures, at the extreme end of the line to Europe, with Canada, another important supplier of strategic materials, next to the end of the line. Canada, Greenland, Iceland, and the United Kingdom lie along the northern edge of the Sea Lines of Communication across the North Atlantic, which give them special significance for the defence of these routes.

For air communications, the great circles between the Eastern USA and Western Europe follow close to the same paths as the sea routes, while those from the Western USA to Northwestern Europe cross over Canada and Atlantic waters north of the sea routes. Air attack of the USA from the USSR, or vice versa, would probably cross over the Arctic Ocean and Canada, and an exchange of ICBMs certainly would.

From these very basic facts of geography, together with Canada's membership in the North Atlantic Alliance and her commitment of Canadian troops to the European Central Front and Northern Flank, it can be seen that a Canadian point of view is taken from next to the end of the line between the USA and Western Europe for defence logistics, and next to the end of the line between the USSR and the USA for air and ballistic missile defence. For logistics, the line lies across the North Atlantic, for air and ballistic missile defence it lies across Canada and the Arctic.

SEA LINES OF COMMUNICATION BETWEEN NORTH AMERICA AND WESTERN EUROPE

Although many things have changed between 1914 and 1985, certain features of the two great Battles of the Atlantic could be repeated in the event of a protracted conventional war between NATO and the WTO. In both of these battles the Sea Lines of Communication (SLOC) from North America to Western Europe were of crucial importance, and were contested by a European power with outlets to the North Atlantic.

As illustrated in Figure I, the submarine threat of World War I, based in Germany and captured bases in Belgium, and able to transfer boats from the Baltic to the North Sea via the Kiel Canada, made its approach to the Allies' North Atlantic SLOC via the Norwegian Sea and the GIUK gap. A mine barrage failed to prevent this

deployment. Surface raiders followed the same route into the North Atlantic, but operated in widely scattered areas all over the world. German blockade runners followed the reverse routes. The neutrality of Norway, Denmark, and the Netherlands aided the Germans, but Allied surface ships eventually captured or destroyed nearly all of the surface raiders and blockade runners. It was the U-boats which came close to severing the SLOC, and were only overcome by the adoption of escorted convoys. The limited endurance of aircraft, which were all land-based in that era, prevented a serious air threat to surface shipping, but maritime patrol aircraft made a contribution to antisubmarine protection of convoys within range of land.

The Second Battle of the Atlantic changed its character in 1940, when Germany captured bases in France and Norway, enabling U-boats, surface raiders and aircraft to reach the Atlantic and Norwegian Seas directly. Prior to this, the situation resembled that of 1914-18. Another important change came in 1941, when the USSR joined the Allied camp and merchant convoys carried strategic goods to Murmansk. Figure II shows the situation pertaining from late 1941 to late 1944, when the Germans were driven from their bases in France. U-boats based in the Bay of Biscay could intercept the SLOC from America and Africa to Britain or the Mediterranean, without having to traverse the GIUK gap,

while those based in Germany or Norway could attack the convoys bound for Russia after the ships had passed the GIUK gap. Long range maritime aircraft from the same areas posed an added threat, including reconnaissance used for the positioning of U-boats, as well as direct attack of the ships. Surface ships based in Germany or Norway could reach the Murmansk convoys directly, but to attain the North Atlantic they had to traverse either the GIUK gap or the English Channel. Successful transits of both were made by both warships and merchant blockade runners. An expensive antisubmarine minefield from Iceland to the Faroes to the UK failed to prevent passage by U-boats.

If a protracted World War III were to break out between NATO and the WTO, the battle of the North Atlantic SLOC could be as indicated in Figure III. The primary submarine threat would be based in the Kola area, and would have to transit the GIUK gap to reach the main shipping route. The air and surface threats would be largely directed along the same paths. To make air attack more difficult, the shipping destined for Europe could pass south of the Azores, only coming northwards within range of friendly air cover based in Southwest Europe. A much smaller but nonetheless vital line of supply would have to be maintained to Norway, Iceland, and Greenland.

With Greenland, Iceland, the Faroes, Scotland, and Norway available to NATO, the GIUK gap offers a favourable line along which to deploy an antisubmarine, antisurface and anti-air barrier.

Bases in the USA, Bermuda, Canada, the Azores, Madeira, Portugal, Spain, France, and England are better placed to provide direct airborne support to the merchant ships.

A second possible source of WP submarines, surface ships, and aircraft to threaten the NATO SLOC comes from the forces based in the Baltic. However, most of the WP maritime weapons systems in the Baltic area appear to be configured for operations in that sea, and for amphibious assault of Denmark and Norway, so as to clear the Danish Straits, the Kattegat, and the Skagerrak for use by the WP. But among the many WP aircraft based near the southeastern coast of the Baltic there are squadrons of maritime strike aircraft with enough range to reach the North Sea and the Norwegian Sea, though to do so would require overflight of Sweden, Denmark, or Germany.

The strength of the Soviet forces in the Kola area, which has been steadily increasing for years, is now so great that they can control the Barents Sea and bid for control of the Norwegian Sea. NATO can contest this only by concentrating its most powerful carrier battle groups. Large scale sealift or airlift to the Northern Flank could be made prohibitively costly, and air superiority very difficult to achieve or maintain, unless NATO can establish control of the Norwegian Sea. Obviously, denial of the use of any of the surrounding naval or air bases would be a severe blow to NATO, and occupation by the WTO forces worse still. Lacking sea control, and suitably placed airfields, NATO could only operate submarines in the Norwegian Sea.

Thus the defence of the transatlantic sea lines of communication divides into two types. One consists of opposition to the transit of Soviet submarines, surface ships, and aircraft from their bases in the Kola, across the Norwegian Sea, as far as the GIUK gap. It could include direct attack on the Soviet bases, but this is likely to be costly and of doubtful effectiveness if confined to conventional weapons, and all too likely to escalate into a full-scale nuclear war if nuclear weapons were employed. It could include an intense sea battle between NATO carrier battle groups and the aircraft, surface ships, and submarines of the Soviet Northern Fleet. Operations of this sort can only be undertaken by the most modern and capable forces of the largest navies on both sides. Associated with the 'Battle of the Norwegian Sea', there would be operations on shore and in shallow waters on the periphery of the Norwegian Sea, including the coasts of Norway and Iceland, the North Sea, and the Baltic exits. The laying of antisubmarine mine barriers in the GIUK gap and both antisubmarine and anti-surface ship mines in the Baltic exits would be important. The naval forces of Norway, Denmark, FRG, and the Netherlands would be fully occupied with these activities. In addition, defences to prevent overflight of Denmark and the FRG would counter another airborne threat to the SLOC.

The other type of defence of the SLOC consists of direct support of the merchant ships, by means such as escort of convoys by warships equipped for antisubmarine and air defence, including defence against antiship missiles, and by distant support by anti-submarine aircraft able to detect and attack submarines during their approach toward the ships. Operations of this type are likely to

take place far to the south of the GIUK gap, and may have to be done without aircraft carriers. For the Canadian navy, based in the Western Atlantic, this seems to be a role more suitable than participation in the high intensity contest for control of the Norwegian Sea.

To protection of ships at sea one should add defence of the seaports, including mine countermeasures and anti-aircraft defence, tasks which should be the responsibility of the nations owning the ports.

SEA- BASED STRATEGIC NUCLEAR DETERRENCE

Of the three elements in the triad of strategic nuclear deterrence, land-based Intercontinental Ballistic Missiles (ICBMs), heavy bombers, and Submarine-Launched Ballistic Missiles (SLBMs), it is the latter which are now considered the most survivable and the most stable. Concealed at sea, they escape the vulnerability of a fixed land-based system to destruction by accurate ICBMs, and of aircraft to a surprise attack catching them on the ground. With the US Navy building Tridents, the Soviet Typhoons and Deltas, and the British and French modernizing their nuclear-propelled ballistic missile firing submarines (SSBNs) and SLBMs, it seems

probable that even an agreement for 'deep cuts' in the numbers of strategic nuclear weapons would leave substantial fleets of SSBNs at sea.

With the long range of the newer missiles (SS-N-8, SS-N-18, SS-N-20, all 6500 to 9100 km; Trident C4, 7400 km), the submarines are able to patrol immense areas of the world's oceans and still keep the majority of their strategic targets within range. Their primary task is to remain safe until needed, so there is no incentive to move into dangerous waters. If the Typhoon and Delta class Soviet SSBNs of the Northern Fleet disperse to the Barents and Norwegian Seas, they can threaten all the strategic targets in Europe and most in North America. Targets out of reach in the Western USA could be covered by SSBNs in the Pacific. From the Greenland Sea they can reach all targets on both continents. However, the fifteen Kola-based Yankee SSBNs would need to transit the GIUK gap in order to reach substantial portions of North America with their 3000 km range SS-N-6 missiles.

The only serious enemy of an SSBN operating quietly in friendly or neutral waters would be a hostile nuclear-propelled attack submarine (SSN). Since NATO has 106 SSNs, the Soviets devote considerable concern to antisubmarine warfare (ASW) for the purpose of defending their own SSBNs in their bastions. In

addition to over thirty SSNs with the Northern Fleet, they have a large number of surface ships and land-based aircraft designed for ASW. In all probability most of these would be deployed to protect their SSBNs in areas north of the GIUK gap.

The Soviet Union has always sought buffer areas between their own territory and that of potential enemies. There are many examples on land, including areas close to Murmansk and to Leningrad taken from Finland in 1940, the appropriation of Estonia, Latvia, Lithuania and Moldavia into the USSR, and the holding of former Japanese territory in Sakhalin and the Kurile Islands. Another form of land buffer has been established with Warsaw Pact allies, and with the neutral Finland and Mongolia, while an attempt is being made in Afghanistan. The only other land borders are the very long one with China, which includes disputed areas, with Iran, and two short frontiers opposite the NATO countries Turkey and Norway.

It would not be surprising to find the same instincts for buffer zones expressed on the sea frontiers, especially now that 'SSBN bastions' can have such significance for strategic deterrence. Obvious areas are the Barents, White, and Kara Seas and the Sea of Okhotsk, bordered by USSR territory only, the Sea of Japan, which is ringed by North and South Korea and Japan as well as the Soviet Union, and the Gulf of Finland, with Finland on its northern edge. But having the Norwegian and Greenland Seas open to

foreign naval and air power must make the USSR very uneasy, and foster a strong desire to convert the waters northeast of the GIUK gap into a fully controlled buffer sea.

For safety of their SSBNs in the northern bastion, the Soviets would be particularly sensitive to any possible NATO antisubmarine operations based in Northern Norway or Svalbard. When NATO surface ships and submarines are equipped with long range sea-launched cruise missiles (SLCMs) with a land attack capability, there will be an additional incentive for the Soviets to achieve sea control in the Norwegian Sea.

AIR LINES OF COMMUNICATION BETWEEN NORTH AMERICA AND WESTERN EUROPE

Although unable to compete with sealift for the transportation of heavy tonnages or large articles, airlift occupies a key role in peacetime commerce for transport of passengers, mail, and small articles requiring rapid delivery. In a crisis, buildup of NATO's strength in Europe would require massive airlift of personnel, and of certain of the most urgently needed military items across the Atlantic. See Figure IV. In the face of active hostilities, routing could be altered, and non-military airfields used, but arrangements for fuel and maintenance could pose problems. Defence of airfields and possibly aircraft in flight would be needed at the European end of the link. Unless NATO were able to achieve air superiority over its own bases, both strategical and tactical airlift could be cut off.

AIRBORNE INTERCONTINENTAL NUCLEAR DETERRENCE

Strategic nuclear deterrence began with aircraft as the carriers of free-falling nuclear fission bombs. The next developments were aerial refuelling, enabling jet propelled bombers to attain intercontinental range, and thermonuclear fusion bombs, greatly increasing the destructive power. Although defences existed, in the forms of radar-directed interceptor aircraft, antiaircraft guns, and surface-to-air missiles, exercises indicated that many if not most of the bombers would get through. Since one large nuclear weapon could destroy all of the aircraft on a large base, a first strike catching the opponent by surprise could succeed in disarming his capability for retaliation.

The consequence of this extremely unstable situation, in which the first to attack could expect to win, was to seek every possible means of obtaining early warning of an approaching air attack, with the intention of using the warning time to flush the bombers off their bases to escape destruction.

The Distant Early Warning Line, consisting of a chain of ground-based radars extending across the North American continent at about 70^{o} North latitude, was supplemented by 'sea wings' consisting of airborne radars patrolling between Iceland and the Azores, and between Alaska and Hawaii. Figure V shows the outer cover of the DEW Line and of the radar in the GIUK gap. By flying dogleg

courses, or by coming down to low altitudes between radar stations, bombers could hope to avoid detection.

Once ballistic missiles were developed to the point that they could achieve intercontinental range with an accuracy comparable with the destructive radius of their thermonuclear warhead, they offered a better means than aircraft for rapid attack, against which there was no defence. The development of long range bombers was halted by both sides, and the air defences of North America run down to a low level. The patrolling of the 'sea wings' over the Atlantic and Pacific approaches was terminated, although the buildup of an air defence radar network in Northwestern Europe improved the probability of tracking bombers approaching North America by routes passing south of Iceland, while radars on the Aleutian Islands might detect an approach crossing west of Alaska.

As the bomber bases became threatened by ICBMs, which could not be detected by the air defence warning systems, it became essential to provide warning of the approach of missiles. For this purpose the Ballistic Missile Early Warning System (BMEWS) was installed, consisting of three enormous ground-based radars located in Alaska, Greenland, and England. See Figure VI. These are able to detect ICBMs about twenty minutes prior to impact in the USA. While far less than the three hours or so of warning that might be available after bombers were detected at the DEW Line, with special measures of preparation it should be possible to get a substantial fraction of the

aircraft off the ground before they were destroyed. It should be added that BMEWS tracks and catalogues objects orbiting in space, as well as being able to detect ballistic missiles. Also, early warning of attack on US bomber bases by submarine launched ballistic missiles (SLBMs) is provided by radars on the United States coast-lines.

The Soviet Bear and Bison heavy bombers were first deployed in 1956, and are still in use, though some are serving as tankers and maritime patrol aircraft. The B52 heavy bomber entered the US Air Force in 1955, the last being built in 1962, with the G and H models still in service. In the nearly thirty years since their first appearance, important improvements have been made to these bombers, notably in the addition of air-to-surface standoff missiles, but no new type of intercontinental bomber has entered either air force. Now in 1985 the Americans are developing the B1B and the Soviets the Blackjack, both capable of intercontinental range, and of supersonic flight at low altitude, and both to carry Air Launched Cruise Missiles (ALCMs). As well as continuing to provide the third element of the triad of strategic nuclear deterrence after the aging Bears and B52s can fly no more, these aircraft can be used with conventional weapons, or for very long range reconnaissance, and may motivate their opponents to spend large sums on air defence against both the bombers and their ALCMs.

Intercontinental bomber sorties would probably follow transpolar routes as indicated on Figure V, although aircraft can deviate from great circle paths in order to evade detection or interception. Aerial refuelling would be carried out over the Arctic or Norwegian Sea, probably both outbound and returning, offering additional possibilities for detection and interception. Thus, NATO air defence systems established along the GIUK gap for defence of the North Atlantic SLOC, or for the defence of Iceland, Norway, and Britain, could also provide early warning of intercontinental bomber sorties. Alternatively, the Soviets might choose routes beyond those areas, so that they would enter North America from the north and northwest rather than the northeast.

A carefully synchronzied attack combining bombers with ICBMs offers the opportunity of mutual support. A small number of widely dispersed bombers might have a better chance of avoiding detection than would missiles, and could attack key command and control centres. Once the enemy had been alerted, a few missiles on key air defence installations could open a safe path for additional bombers.

LAND-BASED INTERCONTINENTAL NUCLEAR DETERRENCE

The first ICBMs were of flimsy construction, and very vulnerable. Their launching took many hours of preparation. Once ready, they had to be launched soon, or be defuelled. Thus, even more than bombers, they invited preemptive attack, and provided their owners with the incentive to use them before they lost them. This fundamental and dangerous instability could not be improved by warning, but only by reducing the vulnerability and preparation cycle. Later models were located in hardened underground silos, and given solid or storable liquid fuel.

It is probable that this period in the early 1960s represented the most dangerous and unstable situation in respect to nuclear deterrence. Both missiles and bombers were vulnerable to a surprise first strike, and in a crisis there would have been a strong incentive for preemptive attack. Since then, the accumulation of SLBMs, the provision of early warning of missile launching, and the hardening of ICBMs has ensured the survival of a retaliatory force quite adequate to inflict assured destruction on the cities of the opponent.

However, in the case of the fixed land-based ICBMs, the development of very accurate multiple independently targetted reentry vehicles (MIRVs) offers a new threat. It is quite practical to site land-based missiles farther apart than the lethal radius of a single large nuclear explosion against the missile in a hardened silo. Thus

one warhead can threaten only one missile, giving the attacker a success rate of at most 1:1. But if a single attacking missile can deliver a number of nuclear warheads to several different silos, each accurate enough to kill its target in its protective shelter, then the attacker could hope for a success rate far in excess of 1:1 in terms of missiles, enabling him to destroy nearly all of his opponents' ICBMs with expenditure of a smaller number of his own.

Three possible countermeasures to MIRV would be a great increase in numbers of ICBMs, increasing the numbers of warheads so that such missiles as might survive would have more potential for retaliation, and making arrangements to launch the ICBMs on warning, rather than waiting for impact. These measures would be destabilizing, the first inviting an increased numerical buildup by the opponent, the last inviting the possibility of war through miscalculation. A number of other countermeasures, depending on various combinations of concealment, mobility, and terminal ballistic missile defence (BMD), have been given serious study, but have not been adopted for ICBMs. It is, however, significant that the largest medium range ballistic missiles (MRBMs) such as the Soviet SS-20 and American Pershing are mobile and able to conceal themselves under natural foliage.

We can be sure that both the USSR and the USA will continue to operate systems to warn of missile launching. Whether they decide to construct and operate active ballistic missile defence beyond the restricted limits agreed in their 1972 ABM Treaty remains to be seen, although such a development would seem less likely in the 1980s than later on.

Some of the installations to provide warning of missile launch are on the ground, necessarily under the paths of the missiles. As shown on Figure VI, there are BMEWS stations in Alaska, Greenland, and the UK, with the other NATO countries in the area being Canada, Iceland, and Norway. But other, more worldwide, coverage of missile launching depends on satellites orbiting in space, and communicating with ground readout terminals in more southerly latitudes.

It is not possible in 1985 to forecast what the characteristics of an intercontinental active BMD system might be. The boost phase of the target missile's trajectory can be detected and tracked from a geostationary satellite, and it seems certain that destruction in the boost phase could be effected only from a space-based weapon system, passing closer to the launch site than would be possible from an equatorial orbit. Interception of the missile in the terminal phase of its trajectory would seem best accomplished by weapons based on the ground near the protected targets, which, for ICBMs, would be in the USA or USSR, although sensors needed for

aiming and control of the ABM weapons might need to be in space, or on territory some distance up range of the impact points. It is mid-course interception that seems most likely to make the northern areas of the planet significant, for reasons evident in Figure VI, although it could be that all of the devices would be in space.

TECHNOLOGICAL DEVELOPMENTS

In spite of the development of large long-range cargo and passenger aircraft, the vast majority of transatlantic cargo, both military and civilian, will continue to be lifted by sea. Special emergency operations, such as the Berlin airlift of 1948, can be mounted for a finite period, but the economic way to move heavy tonnage over long distances is by ship. This is particularly true of bulk cargos such as oil, coal, and wheat, but technological improvements such as containerization and fast roll on - roll off ships, together with mechanized cargo handling, are making shipment of break-bulk cargos faster and more convenient, although increasingly dependent on modern port facilities.

The threat to cargo ships, and troopships, in time of war, will continue to be submarines, aircraft, surface warships, and mines. Antisubmarine warfare has been aided by new devices such as the passive towed sonar array, improved air-dropped sonobuoys,

and mines able to identify submarines at a distance and project torpedoes to hit them. However, these advantages have been more than offset by improvements to submarine performance, including deeper diving and quieter machinery, to antiship weapons, especially antiship cruise missiles, and to intelligence gathering for efficient placing of the submarines, especially by means of reconnaissance satellites able to detect surface ships and report their position in real time.

Protection of surface ships against submarines could take the form of distant support by aircraft, submarines, and surface warships, or of the establishing of barriers to the passage of hostile submarines. But protection of merchant convoys against air attack will require close escort by surface warships fitted for antiair warfare (AAW), now effective to an increasing extent by surface-to-air missiles (SAMs). It will be increasingly important to design SAMs and point defence weapons able to destroy antiship missiles in flight, whether launched by aircraft, submarine, or surface warship.

Defence against surface warships can be effected by maritime strike aircraft, either land-based or carrier-based, by submarines, or by surface warships. The long range of shipborne antiship missiles has altered the character of surface warfare. In the days when both opponents were armed with guns alone, the ship with the

heavier guns (probably the larger ship) had a commanding advantage. Today, a long range antiship missile can be mounted on a very small ship. For coastal defence, antiship missiles can be based on shore.

One very powerful system for AAW, ASW, and anti surface ship defence has been the large aircraft carrier, able to carry and launch high performance fighter aircraft, radar-equipped airborne early warning, antisubmarine aircraft both fixed-wing and helicopter, and bomber aircraft capable of either maritime strike or attack of land targets. However, the cost of these enormous ships, and of the large escort force needed to defend them, has caused the numbers to fall to the extent that it is doubtful that any country other than the USA and USSR will ever build another. Instead, there will be more reliance on helicopters, which can fly off quite small ships, and on fixed wing (or tilt wing) aircraft capable of vertical or short takeoff and landing from vessels displacing not much more than a tenth as much as the giant attack carriers. These smaller carriers will have important capabilities for support of amphibious operations, and for antisubmarine warfare, but will not be able to match the power of the big attack carriers for antiair or anti-surface warfare, or for medium range strike of targets on land.

Defence against mines is most important in the shallower waters at the approach to ports, and requires specialized and

sophisticated mine hunting and minesweeping ships and helicopters. Mines can be laid by aircraft, submarines, and many types of surface ships.

The balance between submarines and ASW favours the submarine to the extent that a submarine which is not obliged by its mission to approach the enemy can almost certainly avoid attack. The mission of the SSBNs is to remain invulnerable so as to provide an assured capability for nuclear retaliation. With their long range missiles, they can patrol far from their targets, and in waters chosen for their own advantage. It seems unlikely that this situation will change in the near future. The waters of the Arctic Ocean, including the vast ice-covered areas, could be favourite patrol areas for all of the navies operating SSBNs. Also, the ability to deliver very accurate MIRVs with SLBMs, perhaps by use of terminal guidance, is likely to be developed before long. If the vulnerability of land-based missiles continues to increase, and if arms control negotiations put an overall ceiling on the total numbers of strategic warheads or launchers, both Superpowers may elect to increase the proportion in the sea-based component.

It seems improbable that revolutionary improvements can be made to large cargo or passenger aircraft, and they will remain extremely vulnerable. Bomber aircraft will be designed to have smaller radar signatures, and will be provided with elaborate

electronic countermeasures. But their most significant improvement is likely to be in standoff air-to-surface missiles, able to navigate to distant targets and difficult to destroy in flight.

Against long range bombers carrying long range standoff missiles the defenders will need long range early warning, and in the case of the USA, Canada, and the USSR, seen from Figure V, this warning will be needed to cover vast areas of uninhabited territory and of Arctic seas, neither offering a hospitable base for large radar stations.

A partial solution to this problem is the Over-the-Horizon (OTH) radar, which uses advanced signal processing and reflections from the ionosphere to achieve ranges of the order of 2,500 km against large aircraft flying at any altitude. Disadvantages are a large dead zone around the radar site, and erratic performance when the ionosphere is disturbed, as frequently happens in polar regions.

Another partial solution to the problem of early warning against an attack is the Airborne Warning and Control System (AWACS), which consists of a large radar in a large aircraft, able to survey a large area for the detection and tracking of aircraft flying at all altitudes. In addition, AWACS has the communications, displays, and information processing equipment permitting it to control interceptor aircraft. However, notwithstanding the abilities of

OTH and AWACS, very great advantages would be obtained if it were possible to locate sensors in satellites able to detect aircraft in flight. In order to keep the distances down, and to cover the most northerly latitudes, it seems likely that a constellation of satellites in properly phased low polar orbits would be required. Readout stations would probably be needed in northerly locations on the ground, suggesting Greenland, Canada, and Alaska.

As regards the future of ICBMs, it appears most unlikely that hardening can win the contest against the accuracy of nuclear warheads. If land-based systems of any kind are to be made invulnerable to nuclear attack, it will have to be done through some combination of mobility, concealment, and active antimissile point defence. Concealment at sea, or under the Arctic ice, is effected today, but this is for SLBMs rather than ICBMs. The technology of future active defences against ballistic missiles is the subject of extensive research and development programs in both the USA and USSR, but the deployment of a highly capable system cannot be expected for many years, or, because of technical difficulties, extreme costs, or negotiated agreements, may never occur.

SUMMARY AND CONCLUSIONS

The strategic situation of the North Atlantic alliance, and its military requirements, can be assessed from various points of view. Much attention is given to the balance of the conventionally armed land and air forces between NATO and the Warsaw Pact, on the European Central Front. In recent years another subject attracting major attention has been the balance in Theatre Nuclear Forces in Europe. Somewhat less has been written about the Northern and Southern flanks, in Europe, and about the defence of North America, and less still about the oceans, air, and space that lie between the Western and Eastern partners in the Alliance. This paper has attempted to focus on the space between the continents, and its strategic significance.

For support of the European members of NATO in a crisis or in war it is absolutely essential that the sea lines of communications across the North Atlantic remain open. This requires the defence of Western shipping against attack by Warsaw Pact submarines, aircraft, and surface warships, which are based in the Kola Peninsula or the Baltic area. This defence can be provided in two ways. One is to cut off the attackers somewhere on their transit from their bases to the shipping lanes. Transit from the Kola area would best be contested in the Norwegian Sea, and in particular across the Greenland-Iceland-UK gap. The obvious place to block

passage of submarines and surface ships from the Baltic is in the Danish Straits, the Kattegat, and the Skagerrak, while maritime strike aircraft will need to be intercepted over Denmark, the FRG, and Norway.

The other form of the defence of shipping is applied along the routes of the ships, through close escort and other types of direct support. While antisubmarine, antiair, and antisurface operations may be carried out at some distance from the ships themselves, escort ships will be needed for antiaircraft and antimissile defence.

Air communication across the Atlantic is also vital to NATO, though more for men and urgent special shipments than for the massive tonnages needed for war and for sustenance of the population. This will require effective air defence in the vicinity of the European terminals, as well as assured supply of aviation fuel at both ends.

Intercontinental nuclear deterrence depends on three elements, of which the submarine launched ballistic missiles offer the best prospect for continuing assured strategic stability. The long ranges of the missiles permit the submarines to patrol far from their targets, and to select remote points of the oceans, or, in the case of the USSR, seas close to their own coasts which can

become defended bastions. The Barents and Kara Seas, and the Arctic Ocean may be favoured, but there will also be a strong incentive to obtain control of the Norwegian and Greenland Seas for protection of the strategic submarines, as well as to secure transits for attack submarines.

Although bomber aircraft, which provided the first capability to deliver nuclear weapons to intercontinental range, have been superseded by ballistic missiles in terms of speed and assured penetration of defences, their threat is being augmented by the development of supersonic speed and of long range air-to-surface missiles. Whether for readying active defences or simply for getting their own bombers off the ground, North America requires early warning of the approach of Soviet bomber aircraft. The routes are likely to be across the polar regions or through the GIUK gap. A chain of ground based radars across Alaska, Canada, Greenland, Iceland, and the United Kingdom provides one opportunity for warning. However, more advanced methods able to cover large uninhabited areas are needed, and will likely be provided through Over-the-Horizon radar, Airborne Control and Warning Aircraft, and space-based detection systems.

Intercontinental Ballistic Missiles with accurate Multiple Independently Targetted Reentry Vehicles now pose a serious threat to their own kind on the opponent's side, as well as to bomber aircraft in their bases and to strategic submarines in port. However,

effective warning systems are in place, able to detect launching and subsequent flight across the polar regions. Active defence to intercept such missiles has not been deployed by NATO, and the characteristics of such a system cannot be known until and unless years of research and development have been completed. However, depending on what type of system were to emerge, there could be a requirement for installations in northerly latitudes.

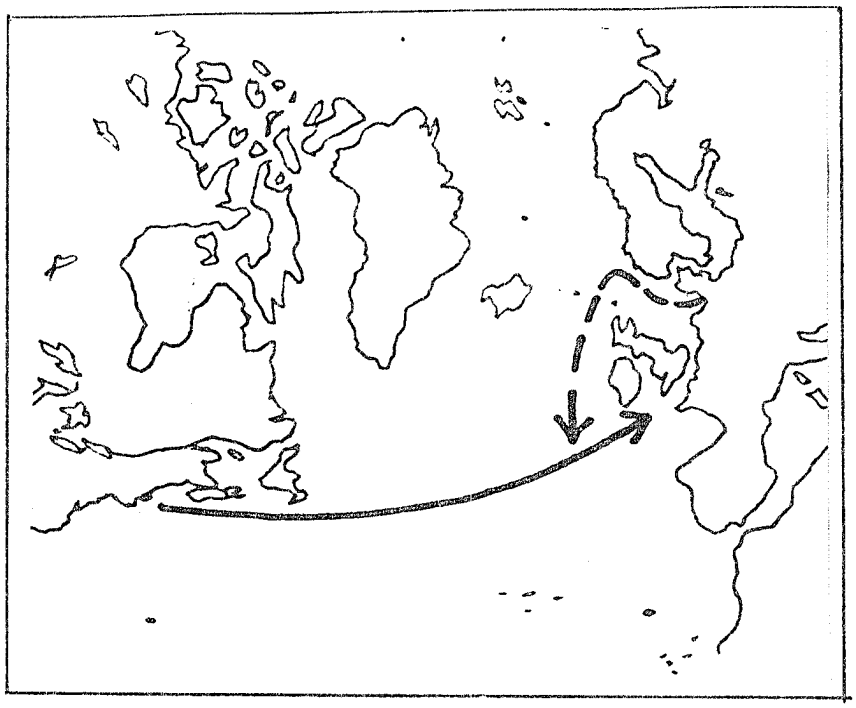

FIGURE I

1917-1918

1939-1940

CONVOYS

U-BOATS

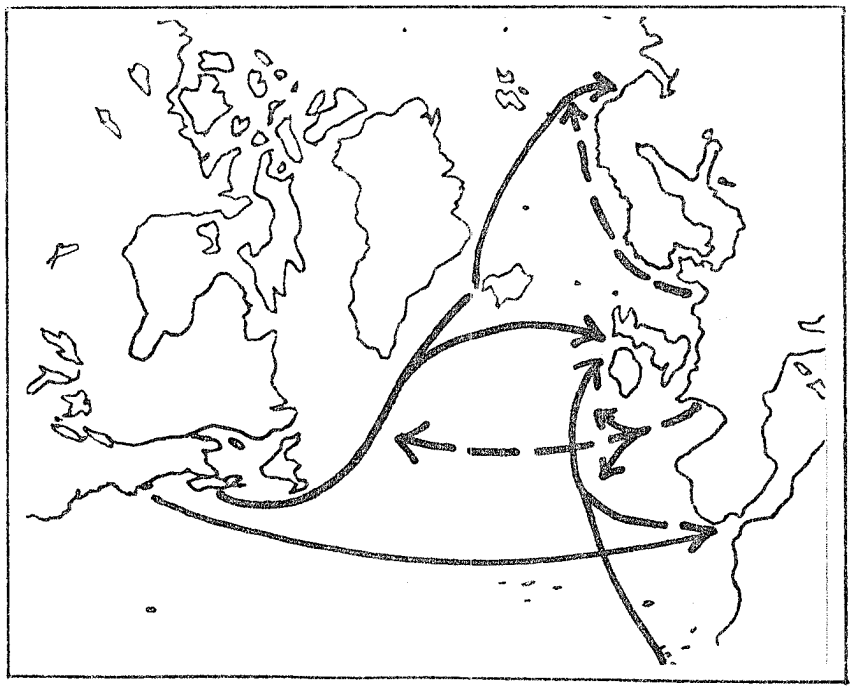

FIGURE II

1941-1944

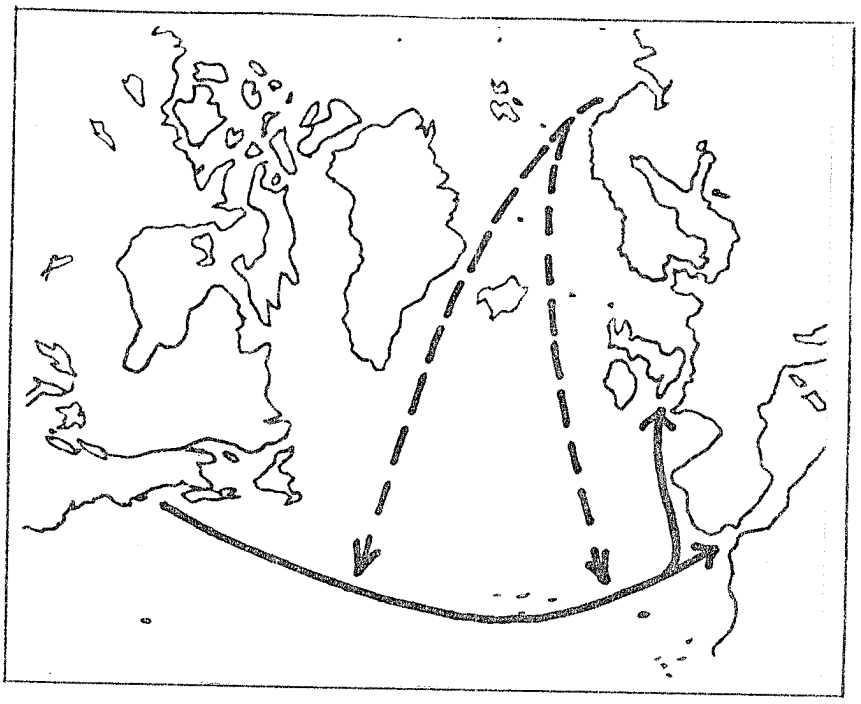

FIGURE III

198X

CONVOYS

SUBMARINES

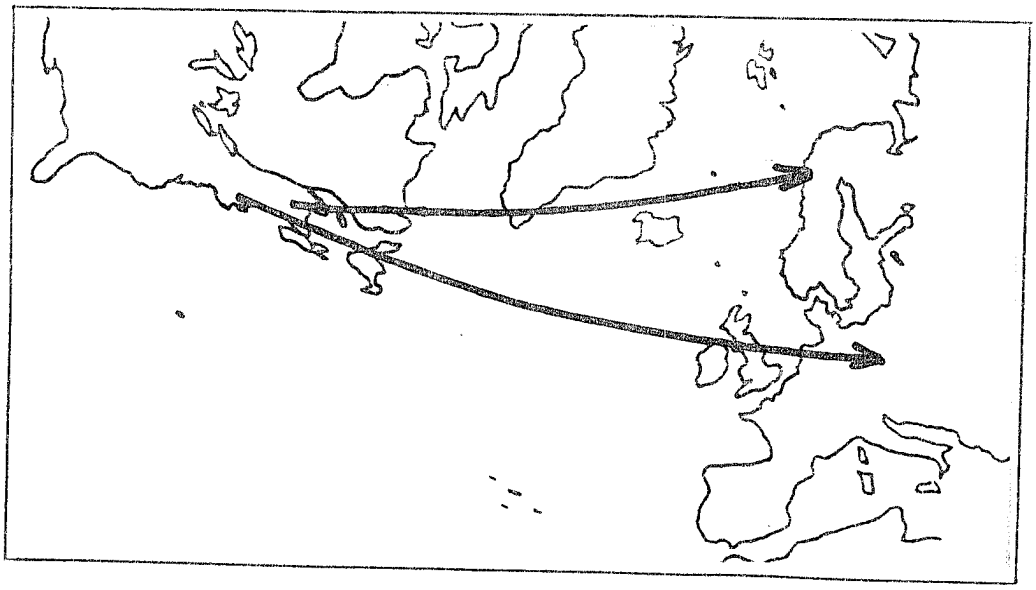

FIGURE IV

AIRLIFT

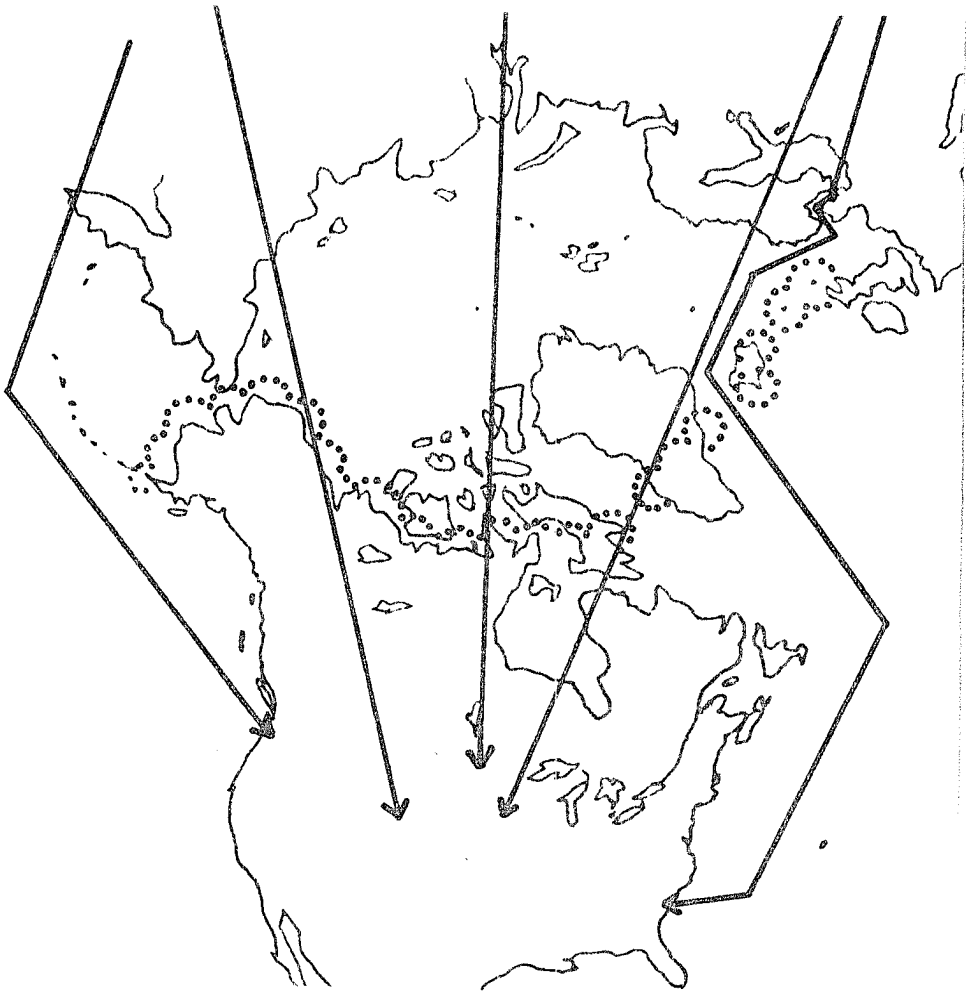

FIGURE V

SOVIET BOMBERS

NATO

EARLY WARNING

RADAR

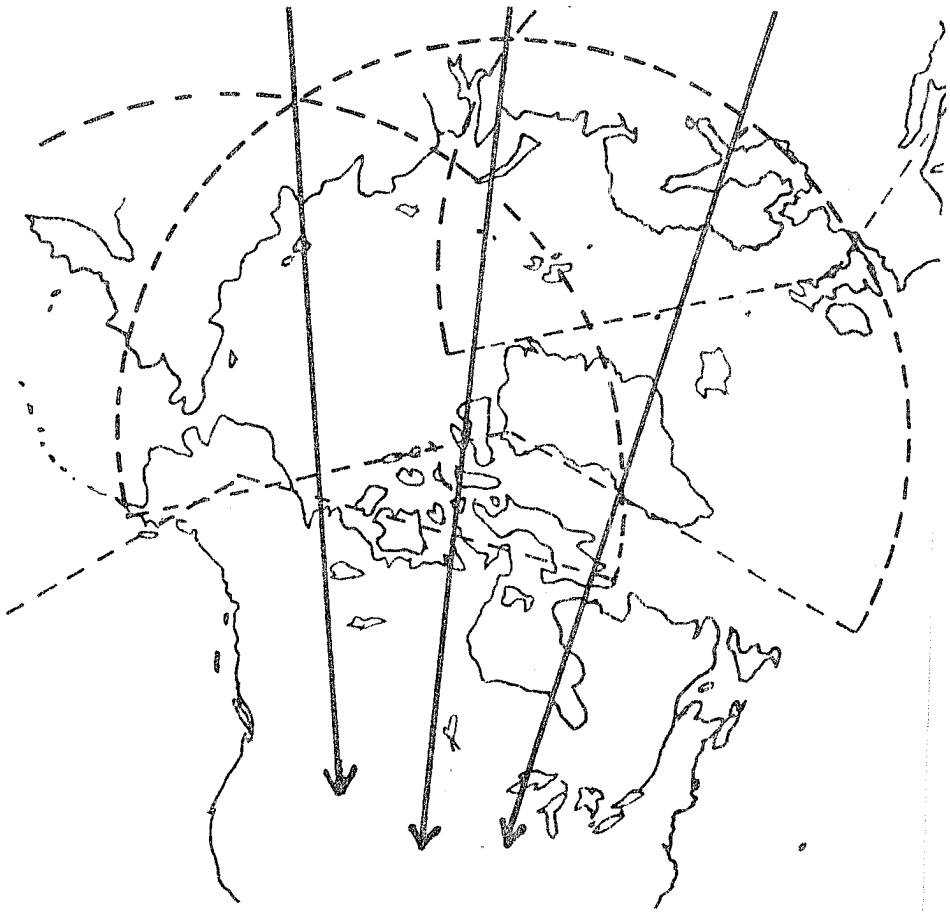

FIGURE VI

SOVIET ICBMs

BMEWS