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(10) DAVID B. KASSING

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NEW TECHNOLOGY AND NAVAL FORCES IN THE SOUTH ATLANTIC

D. KASSING*

INTRODUCTION

There is a growing belief that new types of weapon systems will have major implications for non-nuclear warfare. The weapon technologies that are mentioned most often are: precision-guided munitions, remotely-piloted vehicles, VSTOL aircraft, surveillance and targeting systems, electronic warfare measures and countermeasures, and command, control and communications techniques. One main theme is that the new technology favors defense forces. Large, visible, attacking units, such as tanks, helicopters and attack aircraft, are thought to be more easily detectable by the new sensors and more vulnerable to attack with the new weapons.

Most attention has been given to the implications of these technologies for land warfare, particularly warfare on the central front in Europe.

There has been much less discussion of the consequences of the new technologies for naval warfare, though some of these "new technologies" have been in naval use since 1958. Since Soviet-made Styx missiles sank the Eilat in 1967, perhaps 100 to 150 antiship missiles have been fired in anger, sinking another destroyer, 10-15 smaller naval craft, and about 5 neutral merchant ships.

This paper examines the implications of the new technologies for the naval situation in the South Atlantic. It begins with an examination of maritime interests and the current state of the navies there. Next comes a discussion of new technologies for naval warfare, concentrating on weapon systems directed

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*The views in this paper do not necessarily represent the opinion of the Center for Naval Analyses or the Department of the Navy.

against surface ships and submarines. The paper ends with a discussion of the prospects for proliferation of new conventional technologies into the South Atlantic and the implications for naval warfare in that area. Because there are many naval missions, many new technologies, and many nations, what is offered here should be viewed as a sample of the important issues.

MARITIME INTERESTS IN THE SOUTH ATLANTIC

Maritime interests are typically divided into such categories as sea lanes, fisheries, seabed resources, and ports and bases.

Expressed in these terms, the most important maritime interest in the South Atlantic is clearly the sea lanes. It is not necessary to dwell on the growing importance of Persian Gulf oil to the U.S. and Europe. About 90 percent of that oil is shipped around the Cape and, then, northwest through the South Atlantic. Although the Suez Canal will be widened and deepened to accommodate larger ships, the volume of imports from the Persian Gulf will continue to grow, and the Cape route will retain its predominant importance.

The South Atlantic region is also a source of raw materials. The volume of these shipments to the U.S. in 1985 is projected in table 1.

TABLE 1

ESTIMATED U.S. IMPORTS OF DRY BULK COMMODITIES
FROM SOUTH ATLANTIC -- 1985
(Thousands of long tons)

	South America	West Africa	South Africa	Total	South Atlantic share of total imports by U.S.
Foodstuffs	1,515	9	92	1,615	17.4%
Woods	2	6	-	8	2.9
Fertilizers	-	65	-	65	1.7
Stone, sand, and gravel	6	-	12	18	0.1
Iron ore/ products	7,287	2,753	69	10,109	16.5
Nonferrous ore/ concentrates	717	677	508	1,902	10.3
Coal, coke, and briquets	-	-	388	388	6.2
Total: Dry bulk	9,527	3,509	1,069	14,105	12.3%

Source: Maritime Administration estimates and author's calculations.

Imports of iron ore and semi-finished products account for most of this volume. Other metal ores and concentrates that the U.S. imports in quantity from South Atlantic nations are: beryllium, cobalt, columbium, manganese, platinum, tantalum, and vanadium. But the U.S. does not depend heavily on imports from the South Atlantic, and the volume of shipping required is not large.

The manufactured products that are transported through the South Atlantic do not require much shipping. Moreover, they are of small economic importance, at least to Northern Hemisphere nations.

On a typical day in the late 1980s, there will be about 1,200 ocean-going merchant ships at sea in the South Atlantic.[1] These ships will not, of course, be spread evenly over the area. They will be concentrated in the main sea lanes to North America and Europe. Along the main trade route to Europe, for example, shipping density will be something like one ship per 1,250 square miles, i.e., one ship per 35-mile square.

A second major maritime interest is fishing. About 12 percent of the world's salt water fish catch is taken from the South Atlantic.[2] Half of this is taken by South Atlantic nations (table 2). European Communist nations --

TABLE 2

SOUTH ATLANTIC FISH CATCH *
(As percentage of total world catch)

	1971	1975
South Atlantic nations only	5.6%	6.1%
All South Atlantic catch	10.5%	11.7%

*Excluding catch in inland waters

mainly the Soviet Union -- account for more than half the remaining catch. A wide variety of other nations -- including Spain, Japan, and Cuba -- account for the remainder of the catch. The South Atlantic does not appear to be an important fishing ground for the U.S. fishing fleet.

1. Planning Systems Incorporated, Ship Density Estimates for Traffic along Selected Routes in the Year 1990, 15 December 1975

2. Calculated from data issued by the Food and Agriculture Organization, Yearbook of Fishery Statistics: Catches and Landings, 1975, vol. 40, FAO (1976).

The bed of the South Atlantic, like other ocean bottoms, contains a wide variety of resources, but in quantities far smaller than are available elsewhere. For example, oil off the shore of West Africa amounts to only 3 percent of the estimated world reserves of offshore oil; even if the oil under the waters of the Persian Gulf area is excluded from the calculation, the proportion rises to no more than 7 percent.[3]

Manganese nodules are another seabed resource that is often considered to be economically recoverable in the not-too-distant future. Nodules have been located in the Rio Grande rise, about 800 miles off the coast of Brazil and on the Agulhas Plateau, 300 miles or so off the coast of South Africa. These nodules contain a variety of minerals in addition to manganese -- nickel, copper, and cobalt, for example. But known reserves of these minerals on land amount to at least 30-50 years' supply; large-scale exploitation of these resources at sea, therefore, is likely to be many years away, especially in the South Atlantic.

In sum, the main maritime importance of the South Atlantic to the West is as the route for Persian Gulf oil to reach Europe and North America. As a source of other resources, the area is of only secondary maritime importance.

The South Atlantic has not been an area of direct competition between superpowers. There has been little to draw their fleets there. U.S. Navy ships transit the area and periodically exercise with South American navies but maintain no regular presence in the South Atlantic. The Soviet navy has conducted minor operations off West Africa since December 1970.

The motivation for Soviet naval activities in the South Atlantic is not clear. Acquiring naval facilities is only an intermediate goal. Forces operating from West African facilities could protect Soviet clients, intervene to promote Soviet interests, guard Soviet fishing fleets, or prepare to cut the South Atlantic sea lanes. Some of these motives suggest a Soviet

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3. Calculated from data cited by Don E. Kash et al., Energy Under the Oceans (Norman, Okla.: University of Oklahoma Press, 1973), pp. 310-311.

interest in projecting power ashore; others suggest an interest in sea denial or sea control.

Bases in such places as Luanda or Conakry can serve either purpose. Ranges from these areas to the shipping lanes vary from 800 to 2,000 miles. Such ranges are easily within the combat radii of Soviet ships and land-based naval air. (They are, however, not within the reach of local air or naval forces.)

NAVAL FORCES OF SOUTH ATLANTIC NATIONS

If states as far north as Venezuela and Mauritania are included, there are 26 nations around the rim of the South Atlantic: 20 in Africa and 6 in South America.

According to the latest edition of Jane's Fighting Ships, 22 of these 26 nations have naval forces of some kind.[4] Generally, these are small forces with defensive, surveillance, and coast guard functions. For even these relatively simple functions, their capabilities are small and newly developing.

There is no data about naval budgets for the area, and adding up totals of diverse kinds of ships is a notoriously dangerous way of measuring naval capability. Naval manpower, however, can serve as a rough measure of the relative size of the effort. As table 3 shows, the larger navies are those in South America. Nearly 90 percent of the naval personnel in nations bordering the South Atlantic are in the South American forces, most of them in the Brazilian and Argentine fleets.

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4. John E. Moore, ed., Jane's Fighting Ships, 1976-77 (New York: Franklin Watts Inc, 1976). Jane's shows only 21 naval forces; a modest Angolan force has been added, giving 22.

TABLE 3

NAVAL MANPOWER OF SOUTH ATLANTIC NATIONS

	Naval manpower	Ocean-going combatants*	Submarines	Aircraft
South America				
Brazil	45,300	13	10	90
Argentina	38,900	18	4	150
Venezuela	7,500	10	4	15
Uruguay	3,500	4	0	19
Africa				
South Africa	4,700	9	3	36
Nigeria	2,800	1	0	0
Ghana	1,300	0	0	0
15 other nations	2,700	0	0	0
TOTAL	106,700	55	21	310

*Ships of 1,000 tons or more

Source: Jane's Fighting Ships, 1976-77.

The 100,000-plus naval personnel constitute about 10-12 percent of the total military forces of the area. The NATO nations, by contrast, place about twice this proportion of manpower in naval forces.[5]

There are good reasons for the modest investment in naval forces by the South Atlantic nations. Most of them are poor; in the aggregate, they produce less than 4 percent of the world's gross domestic product. Only four (Argentina, Gabon, South Africa, and Venezuela) have a per capita GNP greater than $1,000.

Little is spent on military forces of all kinds; in only two of these countries was more than $1 billion spent on the armed forces in 1974.[6] On a per capita basis, the two largest spenders -- South Africa and Venezuela -- spend about a tenth as much as the U.S. and the USSR. If naval expenditures amount to about 25 percent of total military spending, Brazil is now spending $500-700 million; Argentina, $200 million; and South Africa, $300-400 million. The U.S. Department of the Navy, by contrast, will spend more than $36 billion in FY 1977 ($33.5 billion for the Navy, $2.9 billion for the Marine Corps).

5. Manpower data taken from Jane's, as well as The Military Balance, 1976-1977 (London: International Institute for Strategic Studies, 1976), pp. 80-81.

6. For data on Brazil or South Africa, see U.S. Arms Control and Disarmament Agency, World Military Expenditures and Arms Transfers 1965-1974 (Washington: U.S. Government Printing Office, 1976), pp. 21, 45 of table II.

There are other reasons as well. In most of these nations, manpower does not cost much. Navies, which are more capital-intensive, are harder to finance. Moreover, between 1945 and 1970, there was next to no extra-regional naval presence in the area to raise concerns about the need for naval defenses. Probably the main explanation is that for most of the South Atlantic nations, the more immediate threats are internal or just across their land borders.

At this point, let us look briefly at six of the South Atlantic nations.[7]

Brazil. The Brazilian navy now operates a 30-year-old, 20,000-ton ASW (antisubmarine warfare) aircraft carrier. It carries 7 20-year-old S-2 aircraft and 4 old SH-3 ASW helicopters and a variety of other helos. The Brazilians have been operating 12 ex-U.S. World War II destroyers and 7 30-year-old ex-U.S. diesel submarines. They are acquiring 6 new missile-equipped destroyers (Vosper-Thorncroft Mk-10 designs) and 3 new diesel submarines (British Oberon class). They have 16 oceangoing patrol craft, 6 minesweepers, 2 LSTs, 4 transports, 3 oilers, and a variety of smaller support ships -- survey ships, tugs, assault craft, and so on.

The main missions of the force seem to be coastal defense and antisubmarine warfare. Protection of shipping along Brazil's 4,700-mile coastline is probably another mission. The need to defend seaborne imports of oil -- from Nigeria and elsewhere -- may shape the future of the navy. For example, Brazil is reported to be considering acquisition of a new helicopter carrier, presumably to replace the old carrier, thereby retaining the ability of the fleet to conduct "blue water" ASW operations.

The first of the new Niteroi 3,800-ton destroyers was expected to be commissioned this month. This will be Brazil's first missile-equipped ship.

Argentina. The Argentine navy operates a carrier of the same age and class as the Brazilian navy, but flies fixed-wing A-4 attack aircraft in addition to S-2 ASW aircraft and SH-61 ASW helicopters. The Argentines have 2 pre-World War II ex-U.S. cruisers, 8 ex-U.S. World War II destroyers, and 2 ex-U.S. diesel submarines. They recently acquired 2 British Type-42 destroyers, each equipped with 2 Sea Dart launchers. (The Sea Dart is a dual-purpose -- surface-to-surface and surface-to-air -- missile launcher.) In 1974 they acquired 2 new German-designed and -built diesel attack submarines. In addition, the Argentines have 2 250-ton, 38-knot attack boats, armed with Israeli-manufactured Gabriel antiship missiles. The Argentine fleet includes, in addition, 17 other oceangoing

7. These six forces were selected to show the variation in forces now operated by South Atlantic states.

corvettes or patrol boats, 6 minesweepers, 4 large amphibious assault ships, 2 transports, 3 tankers, and a variety of smaller icebreakers, tugs, survey ships, assault craft, and so on.

Like the Brazilian navy, the Argentine force appears to have coastal defense and antisubmarine warfare functions. Protection of coastal shipping is the mission for this force. To modernize the force, the Argentines reportedly plan to acquire 6 missile-equipped frigates of British design. In addition, the Argentine navy seems to have a modest sea-based offensive capability.

South Africa. The South African navy's main missions seem to be defense against sea-launched attack, protection of shipping around the Cape, and prevention of infiltration from the seas. But the navy appears to be too small to offer much protection to the 70 or so ships that round the Cape every day, even if they were formed into a single convoy.

At present, the South African fleet operates 2 33-year-old British destroyers, which carry helicopters but no antiship missiles. There are also 3 12-year-old frigates and 4 more formerly British ships from World War II days. When the British refused to supply submarines, the South Africans turned to the French, who supplied 3 Daphne class diesel submarines in 1970-71; 2 larger Agosta class attack submarines, ordered from France in 1975, should be ready before 1980. There are 5 20-year-old, 160-ton patrol craft in the force, soon to be greatly strengthened by the acquisition of 6 Reshef class fast attack boats, each armed with 4 Gabriel antiship missiles. In addition, the South African navy includes 10 20-year-old minesweepers, a fleet replenishment ship, and several smaller support ships.

Nigeria. The first warship ordered for the Nigerian navy was a 160-ton patrol craft, commissioned in 1961. In the mid-1960s, 3 10-year-old ships of the same design were bought from Britain. The Nigerian navy operates the only oceangoing naval ship -- more than 1,000 tons in displacement -- along the west coast of Africa. The 2,000-ton Nigeria was built in the Netherlands in 1964, at a cost of $14 million. Six patrol craft, none of them missile-equipped, were delivered in the early 1970s. At present, there are 6 small combatant ships on order; 2 will be equipped with a single Seacat surface-to-air missile launcher. The Nigerians also have 4 small landing craft, are building a new survey ship, and operating a tug.

The mission of the force seems to be coastal defense and, perhaps, support of forces ashore. The Nigerians have little modern naval power, and the effectiveness of their forces is questionable because of problems with training and maintenance.

Senegal. The Senegalese have 3 P-4 class 250-ton patrol craft, which were built in France. Each carries 8 of the French SS-12 surface-to-surface antiship missiles. There are also 2 82-ton, 20-year-old ex-French patrol craft and 15 patrol boats less than 50 feet in length. The forces appear to have local defense, coast guard, and customs functions.

Guinea. The Guinean fleet contains 4 ex-Chinese Shanghai gunboats of 155 tons each and 8 ex-Soviet patrol boats of less than 100 tons apiece. When these ships are in operating condition, they can provide some surveillance and point defense capabilities.

At present, as we can see, the South Atlantic navies have only local defense functions and largely outdated equipment for performing them. The countries are modernizing their forces more with an eye on each other than with any plan to counter the forces of larger naval powers, such as the U.S., USSR, UK, or France. They may help deter naval attack by neighbors, and some could undoubtedly win local naval conflicts, but none is equipped to control local seas or project military power ashore.

NEW TECHNOLOGY FOR NAVAL WEAPONS

A review of developing naval technology should begin with an assessment of U.S. and Soviet naval developments. There are two good reasons:

First, much of the technology that will be in the hands of smaller navies 10 to 20 years hence is likely to be what is being developed and deployed now by major navies. In fact, many nations have acquired secondhand navies composed of older equipment that was given, lent, or sold to them by the superpowers.

A second reason for paying more attention to developments in the U.S. and Soviet navies is that the balance between them can have important implications for power relationships and local naval developments in the South Atlantic. If either the U.S. or Soviet naval forces should, by technological advance, gain clear superiority, local governments might well reconsider their interests and decide to improve relations with the stronger power, or revise their own naval plans or react in some combination in these ways.

A review of technological development for conventional warfare by the U.S. and Soviet navies shows much concentration on sophisticated and costly technology.

Consider the latest assessment by the Director, Defense Research and Engineering:

> In the maritime balance ... we still probably lead. The Soviets are developing formidable attack submarine technology, a variety of offensive strike cruise missiles, global command and control involving use of satellites, and a world-wide land-based naval aviation arm in the Backfire -- all of which lead to the ability to interdict the sea lanes so vital to the Western world.[8]

In the opinion of DDR&E, the U.S. lead on the oceans is eroding and, if we do not act, the Soviets may gain superiority.

Soviet Naval Development. Information about research and development by the Soviets in new naval technology is obviously limited. We know much more about their current forces than about the capabilities they may be developing for the 1980s and 1990s. Nonetheless, one may venture a few educated guesses.

More and better Soviet satellites -- for surveillance and communication -- are likely to be in the works.

The Soviets have been using satellites for ocean surveillance for 10 years. Their radar satellites have scanned the ocean's surface since 1967. During Okean-75, 2 radar satellites reported on a simulated convoy in the Bay of Biscay. According to Aerospace Daily (2 June 1976), "The radar spacecraft are able to sweep large areas with a signal strong enough to provide data that can be analyzed by commanders on land or sea." A radar satellite could detect large surface ships but might have difficulty distinguishing warships from large, fast merchant ships.

The Soviets deployed a second type of ocean surveillance satellite in December 1974. Satellites of this type do not use radar and are therefore assumed to be electronic listening or television devices. Either type of sensor could help with the problem of ship identification. An electronic listening satellite, of course, requires a "cooperative target," one that is operating its radars or radio communications.

8. Malcolm R. Currie, Director of Defense Research and Engineering, Statement on the Department of Defense Program of Research, Development, Test and Evaluation, FY 1978, 18 January 1977, pp. 1-5.

The Soviets also seem to be developing anti-satellite systems. Development of anti-satellite capabilities resumed last year. Although the main purpose of these systems is not destruction of U.S. fleet satellites, such a capability, once developed, can certainly be used against them. If the U.S. Navy becomes heavily dependent on satellites for communications, command, and control, they will become attractive targets for the Soviets' anti-satellite capabilities.

History suggests that the Soviets will,almost certainly, improve their antiship missiles -- designing them to penetrate U.S. defenses better and to home on selected targets. They have had radar homing, antiship missiles -- PGMs of a sort -- mounted on oceangoing ships since the early 1960s. They now have 9 or 10 different types of antiship missiles deployed, and new classes are expected. Some will be replacements for systems that are now at least 15 years old; some will represent wholly new capabilities. All are likely to be more capable, with longer ranges, greater speeds, less vulnerable flight profiles, and improved seekers. The Soviets are well aware of the U.S. Navy's long and expensive programs to develop large, sophisticated, seabased air defense systems and will, no doubt, avail themselves of electronic warfare measures to blind our defenses during coordinated missile attacks.

In the race against Western ASW technology, the Soviets have regularly introduced new generations of submarines. We can expect quieter Soviet submarines, with better sensors and more effective weapons. Here, too, we may see replacement of older units with improved capabilities, rather than increases in force levels.

Antisubmarine warfare enjoys high priority in the Soviets' doctrine and forces. All of their large new ships, including the carriers of the Kiev class, carry an ASW designation. Presumably, this designation is supported by a research and development program of equally high priority.

But ASW remains a formidable technical problem. According to one informed estimate, the Soviet navy might be able to sink 10 percent of the opposing submarines in a short war at sea.[9] Even Gorshkov admits that ASW remains difficult. In his recent book, he mentions "completely new principles of antisubmarine warfare." He suggests that detection ranges have been lengthened, that homing weapons have been improved, and that the speed and range of torpedoes have been increased.

About other dimensions of the Soviets' ASW capability, however, little is known. For example, the latest Jane's, which tabulates data about the sonar equipment of six navies, includes nothing about Soviet sonar. The book also lists two Soviet torpedoes but gives no data about their design and performance. This is not surprising; operational capabilities, such as detection ranges and torpedo guidance techniques, are much harder to observe than such design characteristics as ship's speed and numbers of missile launchers. It seems reasonable to assume, however, that the Soviets are improving their ASW sensors and weapons while they develop and deploy new types of ships and aircraft.

The Soviets have shown considerable interest in what are called unconventional or non-acoustic ASW techniques. They have worked with infrared, laser, magnetic, radar, and various other techniques to detect the presence of submarines. They have also made reference to satellite detection of submarine wakes. Soviet progress in these areas is counted among the gaps and unknowns in U.S. knowledge of Soviet naval R&D.[10]

The Soviets also seem to be adding a projection or intervention capability to their navy. Certainly, this is one potential use of the Kiev and the Yak-36 Forger VSTOL aircraft it carries. Moreover, the Soviets' amphibious capability, though small, is growing, and they have deployed amphibious ships to all of the major oceans. They also have the command ships and gunfire support forces usually associated with projection operations.

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9. Vice Admiral F. J. Harlfinger II, USN (ret.), cited by Norman Polmar, "Thinking About Soviet ASW," United States Naval Institute Proceedings, vol. 102, Number 879 (May 1976) p. 110.
10. Ibid, p. 128

Lack of support is often called a main weakness of the Soviet navy. It is not that the Soviets lack the technology; they know how to replenish while underway. In fact, a review of ship construction programs during the past decade shows that support and underway replenishment are among the fastest growing sectors of the Soviet navy. In short, this deficiency is rapidly being corrected.

TABLE 4

NEW SHIPS ADDED TO
SOVIET GENERAL PURPOSE NAVAL FORCES
1966-76

	Number of new types	All types	
		Number of ships	Standard displacement
Nuclear submarines	6	53	234,600 tons
Support ships	3	38	181,900
Replenishment ships	5	23	144,075
Cruisers	3	17	123,360
Amphibious warfare ships	2	63	98,900
Destroyers	1	26	92,550
Diesel submarines	2	37	92,500
Smaller combatants	4	232	70,070
Carriers	2	3	70,000
Mine warfare ships	3	109	39,000
Frigates	0	40	38,000
Total	31	641	1,184,955 tons

U.S. Navy Research and Development. Let us turn to the U.S. Navy. The U.S. is now spending over $1 billion a year for research and development for sea control capabilities.[11] What kinds of programs are we buying?

The U.S. Navy is working hard to integrate its capacity for surveillance and target acquisition. By improving the amount of knowledge about enemy force dispositions and speeding the dissemination of this information, the Navy can enhance its effectiveness significantly. Some of these programs will employ aircraft and some will use satellites. The Navy is exploring the use of remotely-piloted vehicles (RPVs) for surveillance, seeking the answers to problems of range, speed, information rate, and launch and recovery operations.

11. See H. Tyler Marcy, Assistant Secretary of the Navy for Research and Development, Statement on Support of Research, Development, Test and Evaluation, Navy, FY 1978 Budget Request, 24 February 1977.

The great advantage of the U.S. Navy lies in its carrier striking forces. The carriers' capabilities to project power ashore are greatly enhanced by precision-guided air-delivered munitions. Since fewer sorties are required to destroy specific targets, more targets can be attacked. The so-called "smart bombs" will also enable the fleet to take enemy overseas bases under fire with less risk of unintended damage to surrounding areas.

The U.S. Navy is also developing its own antiship cruise missiles -- Harpoon and Tomahawk -- and plans to deploy them in submarines, aircraft, and surface ships for attacks on enemy surface ships. These weapons are accurate, long-range, and relatively inexpensive. But they will rely heavily on improvements in surveillance and communications.

Defense against antiship missiles is also receiving major emphasis in the Navy. This money is supporting development of an integrated, fast-reaction, and very expensive ship-based anti-missile system called Aegis. The Navy is also funding development and production of short-range, self-defense systems -- as well as electronic warfare measures -- for surface ships. Whether these systems will yield real gains relative to newly developing missile capabilities cannot, of course, be predicted now.

Antisubmarine warfare is also funded at a figure which does not include expenditures for underseas surveillance. At present, the main sensor employed for detecting submarines is the passive sonar. This device listens for the noise made by the hull or machinery of the submarine as it moves through the water. The emphasis in new sonar technology is to make the "ears" more sensitive, to enable them to hear weaker or more distant noises. But detection ranges remain small relative to the expanses of ocean, and ASW still awaits the "technological breakthrough" that is needed to offset the advantage now held by the nuclear submarine.

The Navy is improving its present underseas surveillance systems. New effects are underway to provide a mobile underseas surveillance capability that can be deployed into the South Atlantic. Data from these platforms can be sent to shore by satellite for processing and the results sent back to the fleet for tactical action. These efforts will improve naval capabilities significantly, at relatively modest cost. Improvements in fleet ASW include the acquisition of better sensors, improved data processing, and new weapons.

Implications for U.S./Soviet Naval Balance. Where will all this leave the balance between the U.S. and Soviet navies? The question cannot be answered in detail, but seven broad judgments about how naval warfare might go in the future are offered here:

1. Although basic naval missions remain unchanged, new developments are raising the possibility of application in the South Atlantic. The Soviets seem to be acquiring the capability to intervene against modest opposition. U.S. ASW capabilities in the South Atlantic, on the other hand, may gain real potential from mobile surveillance systems. But neither power may find it an attractive area for conflict because of logistics or political problems.

2. Both the U.S. and Soviet navies are relying more and more on satellite systems for surveillance and command and control. This means that the ability to conduct naval warfare will be less dependent on geography than in the past. Control will become more centralized, and naval leaders will be able to control naval operations in the South Atlantic as easily as operations in home waters. It may therefore be possible to limit -- in time and space -- a naval conflict that breaks out by mischance.

3. In a full-scale war, satellites can be so important that they may be attacked and destroyed. If they are, the pace of naval warfare may turn out to be far slower than we now envision.

4. Whatever the fate of satellites, large surface ships are likely to be the first major force to sustain large losses. This is as true of the Soviet Kievs, Krestas, and Karas, as for the U.S. carriers and cruisers. The most likely outcome of naval combat on the surface of the oceans is a double knock-out, with both sides losing large portions of their surface forces.

5. When surface forces are intermixed, the one that strikes first gains an advantage; a surprise attack increases that advantage. That side is sure to get off its surface-launched antiship missiles, and if tactical surprise is achieved, may delay or even avoid retaliation. The vulnerability of surface ships to antiship missiles therefore makes for an unstable situation when two surface forces are in the same area at a time of high tension.

6. The continuing naval battle -- if there is one -- will be fought out under the seas. There the situation is different. If there is no unexpected technological breakthrough, a quick victory over submarine forces is impossible. But the West has important advantages in both submarine and antisubmarine warfare, and U.S. ASW capabilities relative to the Soviet submarines seem to be growing. In a long war, then, the Soviets would lose not only their surface forces but their submarines as well.

7. On land, precision-guided munitions are said to reduce the likelihood of damage to unintended targets. At sea, this problem remains. A radar homing missile, for example, will attack any target that comes within its seeker pattern, be it neutral merchant ship or enemy destroyer. Military commanders have generally taken this kind of risk, and neutral ships have been hit by antiship missiles in both the Indo-Pakistani war of December 1971 and the Arab-Israeli war of October 1973. But, given the density of shipping in the South Atlantic sea lanes, navies are likely to have difficulty in hitting the ships of a single nation.

NEW TECHNOLOGY FOR SOUTH ATLANTIC NAVIES

How much of this new U.S. and Soviet technology is likely to see its way into the navies of South Atlantic states in the next 10 to 20 years? What are the implications of this trend?

It seems unlikely that new technologies, per se, will add new missions for the navies of the South Atlantic states. Most likely, their missions will remain local defense, surveillance, and ASW. The main effect of new technology will be in enhancing their capabilities for these missions.

Satellite surveillance systems are probably beyond the means of all but the superpowers. The costs of nuclear submarines will preclude their development and acquisition by all but a few states, none in the South Atlantic. This is also true of most modern ASW systems.

But there are now a variety of naval missile systems as well as small ship sonars, radars, and combat information systems on the market. Some of this technology is now in the hands of South Atlantic navies; for example, the Gabriel, the Seacat, the Otomat, the SS-12, and more will undoubtedly be acquired. Table 5 lists the main missile systems now available for naval applications.

TABLE 5

PRESENT NAVAL MISSILE SYSTEMS

A. SURFACE-TO-AIR MISSILE CHARACTERISTICS

Developer	Name(s)	Guidance	Range (miles)	Speed
France	Masurca	Command, SAR	20	M3.0
UK	Seacat	Command	15	Subsonic
UK	Seadart	SAR	50	M3.0
UK	Seaslug	Beam radar	28	M1.0+
UK	Seawolf	TV plus radar	4	M2.0

B. SURFACE-TO-SURFACE MISSILE CHARACTERISTICS

Developer	Name(s)	Guidance	Range (miles)	Speed
Australia	Ikara	Command, homing torpedo	?	Subsonic
France	Exocet	Inertial, radar homing	28	M0.95
France	Malafon	Radio command	7.5	Subsonic
France	SS.12M	Wire guided	3.7	Subsonic
Intl	Otomat	Radar homing	32	?
Israeli	Gabriel	SAR, TV	12.5	Subsonic
Italy	Seakiller	Beam radar	6.0	Subsonic
Norway	Penguin	Inertial, IR	17.3	M0.7
Sweden	Rb08A	Radio command	150.0	M0.85
USA	Asroc	Homing torpedo	6.0	Supersonic
USA	Harpoon	Radar homing	60.0	Subsonic
USA	Tomahawk	Radar homing	300.0	Subsonic

Source: General Dynamics Corporation, The World's Missile Systems, 3rd edition, November 1976.

The acquisition of these kinds of capabilities by littoral states is likely to continue. But the implications for the regional naval situation depend on how far it goes, and this raises the question of affordability.

This is a hard question to answer. Good data about the costs of new naval systems is rarely available. There is not (and there cannot be) any data on the costs of Soviet arms transfers. Moreover, naval budgets for South Atlantic nations must be estimated with rough techniques on rough data.
The affordability of new forces and capabilities depends on the availability of credit, as well, and this ties back to broader strategic issues.

Table 6 gives estimates of the unit costs implied by transactions involving naval systems between 1973 and 1976. Where appropriate, the estimates have been adjusted to put them on a common basis of 1976 dollars. The available data -- taken from the IISS Military Balance, General Dynamics' The World's Missile Systems (1976), and such periodicals as the International Defense Review -- seldom tell anything about the conditions of sales; i.e., support, training, spare parts may or may not be included.

TABLE 6

UNIT COSTS OF NAVAL SYSTEMS

ANTI SHIP MISSILES	
Exocet - including launcher	$600,000
Otomat	280,000
Gabriel	90,000
Seakiller	60,000
Harpoon	500,000
SEA-BASED ANTI AIR MISSILES	
Masurca	$340,000
Seawolf	41,000
AIRCRAFT	
P-3C land-based ASW	$18,600,000
S-3 ASW aircraft	12,500,000
F-4E fighters	4,600,000
Lynx helicopters	2,500,000
Super Frelon helicopter	3,000,000
Sea King helicopter	3,270,000
SHIPS	
Diesel submarines	$ 37,100,000
Large destroyers - 7000 tons	110,000,000
Frigates -1,500 tons	84,500,000
Missile Patrol Boat - 234 tons	12,000,000
Missile Patrol Boat - 140 tons	5,900,000
Gun Patrol Boat - 120 tons	2,600,000

The next step in examining how much of such technology can be acquired by South Atlantic navies is to estimate their budgets. This, too, can only be done in a rough way. ACDA publishes data on military expenditures but shows only total spending, not the proportion allocated to navies or investment in new naval capabilities.[12] Table 7 gives the ACDA data on arms imported by 19 of the 26 South Atlantic states; military imports by states omitted by ACDA are presumably smaller.

TABLE 7

TOTAL ARMS IMPORTS BY SOUTH ATLANTIC NATIONS, 1965-1974
(Millions)

Brazil	$475*	South Africa	$358*
Argentina	293*	Nigeria	131
Venezuela	291	Zaire	112
Uruguay	47	Guinea	33
		Ghana	25
		Ivory Coast	18
		Congo	11
		Cameroon	6
		Dahomey	6
		Senegal	6
		Togo	6
		Equatorial Guinea	3
		Gabon	3
		Mauritania	2
		Liberia	1

*Nations with significant indigenous shipbuilding and weapons assembly capabilities

For those nations which do not have local arms-producing industries, arms import data provides a measure of ability to finance new hardware acquisitions. Of course, not all the expenditures shown in table 7 procure naval systems. Since navies generally have a higher ratio of hardware costs to manpower costs than other forces, perhaps 50 percent of these expenditures go for new naval systems. If this past history is a reasonable predictor of the future, funding available for naval procurement will remain quite small, even if substantial growth rates are assumed.

12. U.S. Arms Control and Disarmament Agency, op. cit., table IV.

Table 8 describes and costs a nominal small, but modern, navy for the 1980s. At an annual cost of $115 million, such a navy seems to be easily within reach of the regional powers -- Brazil, Argentina, South Africa, and Nigeria.

TABLE 8

NOMINAL "SMALL" NAVY FOR 1980s

(Million)

Number in force		Procurement cost	Annual operations	Twenty-year systems cost
3	Diesel submarines	$37.0	$3.5	$ 321
2	Missile frigates	84.5	5.0	369
2	Frigates	70.0	4.0	300
5	Corvettes	40.0	3.0	500
10	Fast patrol boats	12.0	0.7	260
10	P-3 aircraft	18.0	0.8	340
10	ASW helicopters	3.0	0.3	90
	SUBTOTAL - Force investment and operational costs			$2,180
	Command, training and administration (1/3 of operating costs)			115
	Total cost			$2,295
	Average annual cost			$ 115

Thus, one result of the spread of new technology might be an increasing imbalance between the naval strengths of the regional powers and those of the less developed South Atlantic states. On net, these larger regional powers should be better able to carry out offensive naval actions against their poorer neighbors. This contrasts with the common belief that the new technologies will favor the defense. The reason is not necessarily in the technologies themselves, but in the relative economic strengths of the South Atlantic nations.

Last, there is a question of whether the regional powers' navies -- with larger forces of frigates and patrol craft armed with sophisticated antiship missiles, new diesel submarines, land-based air, PGMs, etc. -- could deny the superpowers the naval capability to project forces into the South Atlantic. The answer is: probably no . And the reason is relative economic

strength as well. No doubt, a "new technology navy" could inflict an initial shock if it struck first at a U.S. or Soviet force in the South Atlantic. This possibility should make the superpowers less likely to engage in casual "gunboat diplomacy" against any nation with such a navy. But it is clear that either the U.S. or Soviet fleets could soon muster the naval forces to destroy completely even the largest of the regional navies.

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