World Armaments and Disarmament

SIPRI yearbook 1979

Stockholm International Peace Research Institute

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Stockholm International Peace Research Institute

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Stockholm International Peace Research Institute

Taylor & Francis Ltd
London
1979

First published 1979 by Taylor & Francis Ltd
10-14 Macklin St, London WC2B 5NF

Distributed in the United States of America by
Crane, Russak & Company, Inc.,
3 East 44th Street, New York, N.Y. 10017
and in Scandinavia by
Almqvist & Wiksell International,
26 Gamla Brogatan,
S-101 20 Stockholm, Sweden

ISBN 0 85066 181 1
ISSN 0347 2205

Typeset by Red Lion Setters, Holborn, London,
and Lancashire Typesetting Co. Ltd., Bolton.
Printed and bound in the United Kingdom by
Taylor & Francis (Printers) Ltd., Rankine Road,
Basingstoke, Hampshire RG24 0PR

Previous volumes in this series:

SIPRI Yearbook of World Armaments and Disarmament 1968/69
SIPRI Yearbook of World Armaments and Disarmament 1969/70
World Armaments and Disarmament, SIPRI Yearbook 1972
World Armaments and Disarmament, SIPRI Yearbook 1973
World Armaments and Disarmament, SIPRI Yearbook 1974
World Armaments and Disarmament, SIPRI Yearbook 1975
World Armaments and Disarmament, SIPRI Yearbook 1976
World Armaments and Disarmament, SIPRI Yearbook 1977
World Armaments and Disarmament, SIPRI Yearbook 1978

PREFACE

The tenth issue of the *SIPRI Yearbook* continues our analysis of the world's arms races, and the attempts to stop them, up to 31 December 1978. As in all SIPRI publications, information has been obtained from open sources only.

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Acknowledgements

The Yearbook team wish to thank the Institute's librarians, Gunnel von Döbeln, Charu Jasani and Janet Meurling; the press cutters, Per-Erik Branke and Michal Lucki; and the secretarial staff for their assistance in preparing the Yearbook. Special thanks are also extended to Kimmo Persson for his considerable help in establishing the computer storage system.

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Introduction

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I. Militarization of the Earth and outer space

One barrier to controlling the arms race is the growth of vast bureaucracies dealing with military affairs in the great powers. Moreover, a large number of academic and research activities are financed by their military budgets. The so-called military–industrial complex has, therefore, grown into a military–industrial–bureaucratic–academic complex [1]. The total vested interest in maintaining and increasing the level of military spending is often so huge and diverse as to be almost politically irresistible. Just how far militarization has already progressed is not generally realized. The first three chapters of this Yearbook, with extensive tables on military expenditures and on world arms production and trade, indicate the scale of activities involved.

Military expenditure

World military expenditure is now running at an annual rate of about $410 thousand million, or nearly $1 million per minute—an increase (in constant prices to take inflation into account) of about 50 per cent over the past two decades. The Third World's share of this total has increased over this period from about 4 per cent to about 14 per cent.

The rate of increase of Third World military spending varies considerably from region to region. During the 1970s, for example, Middle Eastern (including Egyptian) spending increased (in constant prices) about 2.8 times. African (excluding Egyptian) military spending increased about 2.4 times. Asian and Latin American military spending each increased about 1.5 times. For the Third World as a whole, military spending has so far doubled during the 1970s, increasing faster than the GNP. It is noteworthy, however, that Middle Eastern (including Egyptian) military spending since 1976 has actually decreased by about 20 per cent. Nevertheless, about 45 per cent of total Third World military expenditure comes from the Middle East. Asia spends about 27 per cent, while Africa and Latin America each spend about 14 per cent.

In per capita terms, the Middle East region is still the biggest spender in the Third World, spending roughly $250 per capita in 1977. Africa and Latin America follow, each spending about $20 per capita, while

Asia spends about $10 per capita. These figures should be compared with about $250 per capita for industrialized countries in 1977.

Many believe that the Third World can least afford increasing levels of military spending and that most, if not all, available resources should go to development. It is for this reason that Third World military spending provokes comment, even though, compared with that of industrialized countries, it is still quite low in absolute terms.

The link, or lack of it, between disarmament and development is a major current issue of debate. In the words of Willy Brandt, Chairman of the Independent Commission on International Development Issues,

> . . . mankind may well face a threat in the decades ahead of us not only from an uncontrolled arms race, but also from the shocks emanating from a growing or unchanging differential between poor and rich countries.
>
> But if serious efforts are undertaken to curb a further rise in this arms spending in the coming decade, that will give rise to the important question of rechannelling resources. Firstly within the national economies but also, I trust, over and beyond that in helping to bridge the gap between North and South [2].

Unfortunately, in this as in many other global issues, it is easier to state what should be done than how it can be done.

Other major factors leading to global militarization include the international arms trade and the sharp increase in the number of countries producing their own weapons.

The arms trade and production

Almost all of the considerable number of wars which have taken place since World War II have been fought in the Third World. Most of the weapons used in these wars have been acquired through the international arms trade.

The value of the major weapons—aircraft, armoured vehicles, missiles and ships—supplied to the Third World has been increasing at an annual rate of 25 per cent since 1974. New orders of all types of military equipment are estimated to be running at about $20 000 million per year.

It is not unreasonable to regard the arms trade as virtually out of control. Considering the danger that a conventional war in a Third World region may escalate to a nuclear world war, it is crucial that the arms trade be soon brought under control. It is, therefore, encouraging that some efforts—however tentative—are being made to limit arms sales. In the USA, the Carter Administration is attempting to achieve some limits unilaterally, and bilateral discussions between the USA and the USSR on limitation have begun.

The number of countries producing their own weapons is increasing rapidly. Today 54 countries are producers of major weapons, 23 of them in the Third World. If small arms are included, then the number of countries producing weapons is, of course, much larger.

But militarization extends far beyond the land mass. The oceans and outer space are increasingly involved.

Naval arms

Many new technologies are being introduced into navies (see chapter 6). In particular, new generations of naval missiles and their associated electronic systems follow each other with bewildering rapidity. In some cases, the rapidity is such that new missiles are developed before their predecessors are deployed. For example, the supersonic US Condor missile, judged to be an excellent air-to-ship missile, was developed but never deployed simply because it was overtaken by the Harpoon missile.

Currently, NATO and Warsaw Treaty Organization (WTO) countries operate 485 and 195 major naval warships respectively—including aircraft carriers, cruisers, destroyers and frigates. The current tendency is to modernize the fleets without increasing the number of ships. Increasing quality without increasing quantity is a common characteristic of today's arsenals, both conventional and nuclear.

The characteristics of great power navies vary so considerably that comparisons can be misleading. It is worthy of note that the Soviet Navy is considered probably not capable of sustained fighting. Its surface strength is mainly confined to just one powerful salvo, at least as far as ship-to-ship missiles, the main naval weapons of today, are concerned.

An important current characteristic of the naval arms race is the proliferation of light naval forces such as fast patrol boats. Most industrialized countries are building up fleets of light ships. The USA, the UK and France are among the exceptions. Reasons for this development include effectiveness and relative cheapness. A modern fast patrol boat armed with missiles, for example, can have as much fire-power as a World War II cruiser. A fast patrol boat costs about $30 million, whereas the production cost of a modern cruiser is about $500 million.

Light naval forces are often attractive to Third World countries as a relatively cheap solution to their perceived security needs. Many such countries simply cannot afford major naval warships.

All countries other than land-locked ones are, or may be, faced with the problem of policing an expanded economic zone or patrolling widened territorial waters. For these purposes, light naval forces are often seen as ideal. Expanded navies can, however, change regional power balances and stimulate regional naval arms races.

Another important indication of the militarization of the oceans is the growing number of nuclear-powered submarines. Since 1960, the number of operational nuclear submarines has increased from zero to 278. Of these, the USSR has 149, the USA has 111, the UK has 14, and France has 4.

Military satellites

The fact that the militarization of space continues unabated is clearly shown in chapter 4. During 1978, 112 military satellites were launched —a rate of about one every three days. This brings the total of military satellites launched since the space age began in 1957 to 1 601, about 75 per cent of the total number of satellites launched.

Of the 112 military satellites launched last year, 19 were US, 91 were Soviet, 1 was Chinese, and 1 was launched by the USA for NATO. Soviet satellites are generally relatively short-lived and, therefore, numerous. But the USSR is just beginning to launch longer-lived satellites. The life of some of its photo-reconnaissance satellites, for example, has increased from 13 to about 30 days.

The purposes of military satellites include reconnaissance, geodesy, navigation, communications, early warning of attack and meteorology. Over 50 per cent are for reconnaissance, and about 25 per cent are for military communications.

In May 1978, the USSR is said to have launched a hunter–killer satellite as part of a programme to test the feasibility of intercepting hostile satellites in space. This activity is a dangerous one since it threatens the other side's reconnaissance and early-warning satellites. The USA and the USSR are, however, currently discussing ways to control anti-satellite activities.

A dangerous development would be space-borne ballistic missile defence systems. The capability of destroying enemy missiles in space may encourage a first strike. Currently, methods under consideration for the destruction of enemy warheads include the use of high-power lasers and heavy-particle beams in space. Of these two techniques, lasers appear to be the most likely to work as a space-based system. Lasers may also be used in the future to disable enemy satellites.

II. The nuclear threat

In spite of the fact that the upkeep of conventional weapons and forces accounts for some 80 per cent of military spending by the great powers, nuclear arsenals are the greatest threat to humankind. It is widely believed that the more nuclear weapon powers there are, the greater is the probability of nuclear war. Preventing the spread of nuclear weapons is therefore of crucial importance to world security. Unfortunately, no effective political barrier to proliferation has yet been found. Indeed, increasingly cut-throat commercial competition in the nuclear market-place is making the evolution of a satisfactory non-proliferation régime much more difficult. Control mechanisms and proliferation resistance are discussed in chapter 5.

The extent of US and Soviet strategic nuclear forces is detailed in appendix 7A.

Current US operational strategic nuclear forces are probably loaded with about 9 000 nuclear warheads, with a total explosive power equivalent to that of roughly 3 500 million tonnes of high explosive. Operational Soviet strategic nuclear forces could deliver about 5 000 nuclear warheads, with a total explosive power equivalent to that of about 6 000 million tonnes of high explosive. In the tactical nuclear arsenals there are calculated to be several tens of thousands of nuclear warheads, each on average some four times more powerful than the Hiroshima bomb. These add perhaps another 3 000 million tonnes of TNT equivalent to make a total of about 13 000 million tonnes—the equivalent of about 1 000 000 Hiroshima bombs or of about 3 tonnes of high explosive for every man, woman and child on Earth.

The nuclear arsenals are, however, still being quantitatively increased. And planned deployments are unlikely to be significantly affected by the proposed Strategic Arms Limitation Treaty (SALT II).

Strategic arms limitation

In mid-1977, the USA and the USSR agreed on a general framework for SALT II having three components: first, a treaty lasting until 1985; second, a short-term protocol dealing with problems for which long-term solutions have yet to be found; and third, a joint statement of principles for SALT III.

As of March 1979, most of the technical difficulties that have arisen during the negotiations have been solved and a joint draft treaty, more than 60 pages long, has been negotiated. The treaty, *as it now stands*, will establish equal limits for the USSR and the USA on the total number of strategic nuclear delivery systems. An initial total of 2 400 strategic systems will be reduced to 2 250 during the term of the treaty. Within this total, there will be a limit of 1 320 on the total numbers of ballistic missiles[1] equipped with multiple independently targetable re-entry vehicles (MIRVs) and bombers armed with long-range cruise missiles.

[1] Strictly speaking, the treaty limits apply to missile launchers rather than missiles.

The new agreement will limit the number of MIRVed land-based intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs) to 1 200. A further limit of 820 will be placed on MIRVed land-based ICBMs. The USSR will be allowed 308 heavy ICBMs of the SS-18 type. There will be an agreement to exchange data on the numbers of strategic weapon systems in constrained categories. Given the Soviet habit of extreme secrecy about strategic (and other) weapons, this agreement to exchange data is a considerable, and welcome, breakthrough.

Within the numerical limits, each side is free to determine the structure of its strategic nuclear forces. The equal numerical limits and the freedom to mix strategic systems within them is intended to provide for 'equivalence' given the differences in the make-up of the Soviet and US strategic nuclear forces.

The proposed treaty includes very detailed technical descriptions of strategic nuclear weapon systems, restrictions on certain new strategic weapons, and provisions to improve verification.

The protocol—probably lasting to 1981—will allow flight-testing and development of air-, ground-, and sea-launched cruise missiles to unlimited range but will ban the development of ground- and sea-launched cruise missiles capable of a range greater than 600 km. There will be no maximum on the range permitted for deployed air-launched cruise missiles (ALCMs).

The deployment of mobile ICBM launchers will be banned for the period of the protocol as will the flight-testing of ICBMs from such launchers. Flight-testing and deployment of new types of ballistic missiles will also be limited. The treaty will provide for advance notification of certain ICBM test launches. SALT II will not affect continued nuclear (or conventional) cooperation with allies.

The Soviet Backfire bomber will apparently not be counted as a strategic bomber within the total limit for strategic delivery vehicles but the USSR will be prohibited from deploying the Backfire as a strategic bomber against the USA. In addition, the rate at which the aircraft may be produced in future will probably be stipulated.

The statement of principles for SALT III includes commitments to further reductions, more comprehensive qualitative constraints on new systems, and provisions to improve verification. Given the difficulties in agreeing on the details of SALT II, this premature concern about SALT III indicates the professional optimism of the SALT negotiators.

What effect will the proposed SALT II treaty have on the nuclear arsenals? The USA currently admits to having 1 710 ballistic missiles (1 054 ICBMs and 656 SLBMs) of which 1 046 (550 ICBMs and 496 SLBMs) are MIRVed. About 300 B-52s are assigned strategic roles

Table 1. US and Soviet strategic delivery systems, levels and limits

Weapon systems	September 1979 levels USA	USSR	1974 Vladivostok limits	Tentative SALT II limits[a]
Heavy ICBMs	54	308	308	308
Other ICBMs	1 000	1 090		
SLBMs	656	979		
Long-range bombers (B-52s)	300[b]/569[c]	140[b]/150[c]		
Total strategic nuclear delivery systems	**2 279**[d]	**2 527**[d]	**2 400**	**2 250**
MIRVed ICBMs	550	524		820
MIRVed SLBMs	496	64		
Total MIRVed missiles	**1 046**	**588**	**1 320**	**1 200**
MIRVed ICBMs + SLBMs + aircraft with long-range cruise missiles				1 320

[a] As announced by the USA, February 1979.
[b] Estimate of number of strategic bombers in fully operational (intercontinental) status, excluding aircraft used for training, in storage, in mothball and in reserves.
[c] Total number to be used in SALT II limit.
[d] Number to be compared with SALT II limit.

(although all 569 B-52s which exist will be counted in the SALT II limits, including about 90 in very deep storage). US and Soviet strategic delivery systems are detailed in table 1.

The USA has not officially announced plans to increase the number of its MIRVed ICBMs above the current level of 550. The first Trident strategic nuclear submarine is scheduled to be operational in 1981. Others may become operational at a rate of about three every two years.

The deployment of ALCMs is planned to begin in late 1982, perhaps at the rate of about 40 per month. Thus 80 B-52Gs could each be armed with 20 missiles by the end of 1985.

According to US estimates, the USSR had in September 1978 deployed 2 347 ballistic missiles (1 400 ICBMs and 947 SLBMs), of which 386 (354 ICBMs and 32 SLBMs) are MIRVed (see table 3). About 140 Soviet long-range bombers are probably assigned strategic roles (although the total number of Soviet bombers to be counted within the SALT II limits is 150, including some aircraft not in fully operational status). By September 1979, it is estimated that the USSR plans to increase its strategic forces to 2 377 ballistic missiles (1 398 ICBMs and 979 SLBMs), of which 588 (524 ICBMs and 64 SLBMs) will probably be MIRVed. Under SALT II, the USSR will probably have to dismantle about 250 strategic delivery systems.

The USSR has recently deployed MIRVed missiles at an average rate of about 150 per year. The USSR can be expected to increase its MIRVed ICBM force to 800 by 1985.

According to current deployment plans, the USA, for example, will in 1985 probably have 550 MIRVed ICBMs, 496 MIRVed SLBMs on 31

Table 2. Current US strategic delivery capability

Vehicle	Number of vehicles deployed	Number of warheads per delivery vehicle	Total delivery capability (no. of warheads)	Total yield per delivery vehicle (Mt)	Total delivery capability (Mt)
MIRVed vehicles					
Minuteman III	550	3	1 650	0.51	280
Poseidon C-3	496	10[a]	4 960	0.4	198
Sub-total	1 046		6 610		478
Non-MIRVed vehicles					
B-52	300[b]	11[c]	4 300[d]	12[c]	3 800[d]
Titan II	54	1	54	7.5	405
Minuteman II	450	1	450	1.5	675
Polaris A-3	160	3	480	0.6	96
Sub-total	964		5 284		4 976
Total	**2 010**		**11 894**[e]		**5 454**

[a] Average figure.
[b] Estimate, excluding aircraft used for training, aircraft in storage and reserves. There are currently 478 B-52s, which can be made ready for flight in a relatively short time.
[c] Excluding the nuclear-armed short-range attack missile (SRAM). Maximum loading. Operational loading per aircraft may be four bombs, each of one megaton.
[d] Including SRAM. Maximum loading.
[e] Of these, 7 274 are independently targetable warheads on ballistic missiles.

Table 3. Soviet strategic missile delivery capability, September 1979

Vehicle	Number of vehicles deployed	Number of warheads per delivery vehicle	Total delivery capability (no. of warheads)	Total yield per delivery vehicle (Mt)	Total delivery capability (Mt)
MIRVed vehicles					
SS-17	100	4	400	2	200
SS-18	114	8	912	4	456
SS-19	310	6	1 860	3	930
SS-N-18	64	3	192	0.6	38
Sub-total	588		3 364		1 624
Non-MIRVed vehicles					
SS-9	102	1	102	20	2 040
SS-11	620	1 or 3	1 300[a]	1 or 0.6	550[a]
SS-13	60	1	60	1	60
SS-18	92	1	92	20	1 840
SS-N-5	21	1	21	1	21
SS-N-6	528	1 or 2	700[a]	1 or 0.4	430[a]
SS-N-8	354	1	354	1	354
SS-NX-17[b]	12	1	12	1	12
Sub-total	1 789		2 641		5 307
Total	**2 377**		**6 005**[c]		**6 931**

[a] Estimate.
[b] MIRV capability.
[c] Of these ballistic missile warheads, 5 153 are independently targetable.

Table 4. Probable US strategic delivery capability in 1985, with or without SALT II

Vehicle	Number of vehicles deployed	Number of warheads per delivery vehicle	Total delivery capability (no. of warheads)	Total yield per delivery vehicle (Mt)	Total delivery capability (Mt)
MIRVed vehicles					
Minuteman III	550	3	1 650	0.51	280
Poseidon (C-3 and C-4)	640	10[a]	6 400	0.4 or 0.8	350
B-52 with ALCM	80	20	1 600	4	320
Sub-total	1 270		9 650		950
Non-MIRVED vehicles					
B-52 (penetrating)	220	11[b]	3 420[c]	12[b]	2 840[c]
Titan	54	1	54	7.5	405
Minuteman II	450	1	450	1.5	675
Polaris	64	3	192	0.6	38
Sub-total	788		4 116		3 958
Total	**2 058**		**13 766**[d]		**4 908**

[a] Average.
[b] Excluding SRAM. Maximum loading.
[c] Including SRAM. Maximum loading.
[d] Of these, 8 618 are independently targetable warheads on ballistic missiles.

Poseidon nuclear submarines, 144 MIRVed SLBMs on six Trident submarines and 80 B-52G bombers each equipped with 20 cruise missiles. (The present plan is eventually to arm all 173 B-52Gs with cruise missiles.) These strategic delivery systems could deliver about 10 000 nuclear warheads—1 600 by cruise missiles, about 1 600 by land-based ICBMs and about 6 400 by SLBMs. Single-warheaded ICBMs, the remaining SLBMs and the other strategic bombers could deliver an additional 4 000 warheads (see table 4).

Currently deployed US ICBMs, SLBMs and strategic bombers can deliver about 10 000 nuclear warheads (table 2). The total of about 14 000 US strategic nuclear warheads which may be deployed in the mid-1980s thus represents a significant increase in the size of the US nuclear arsenal.

A SALT II treaty like that which the USA and the USSR are negotiating will not greatly affect quantitative increases in the US nuclear arsenal as currently planned. Similarly, the size of the Soviet nuclear arsenal is likely to increase considerably.

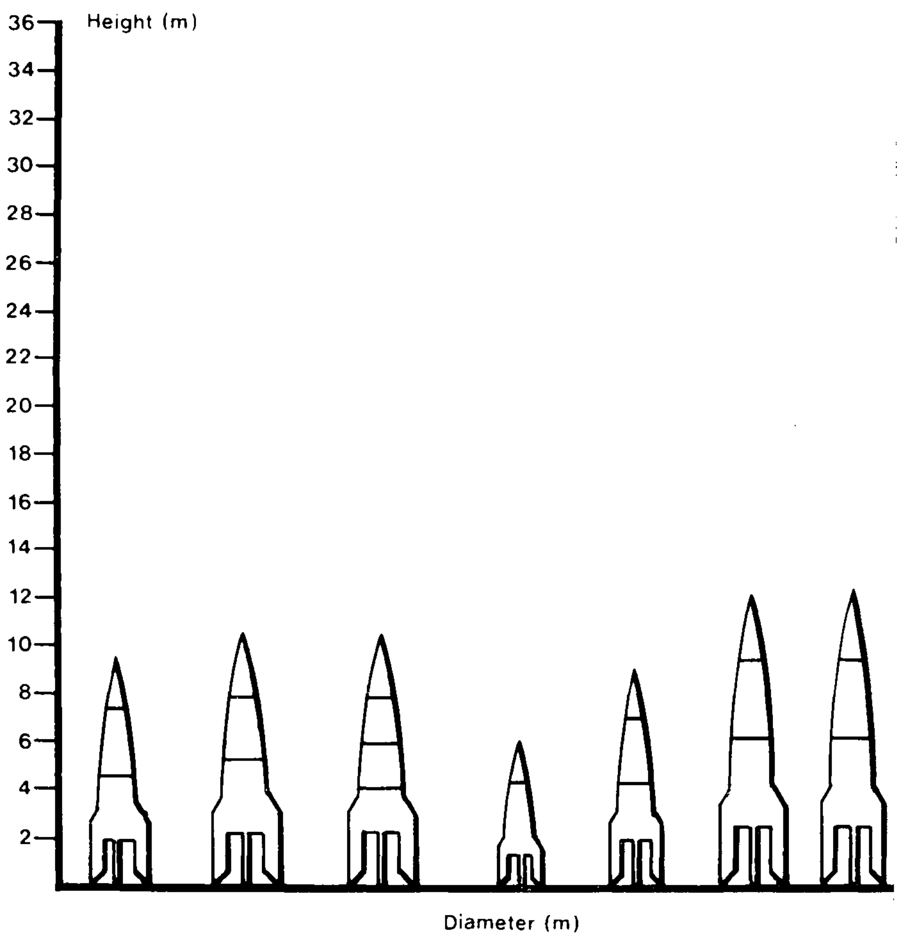
III. The qualitative arms race

Qualitative developments in nuclear warheads, however, particularly those with improved war-fighting rather than war-deterring characteristics,

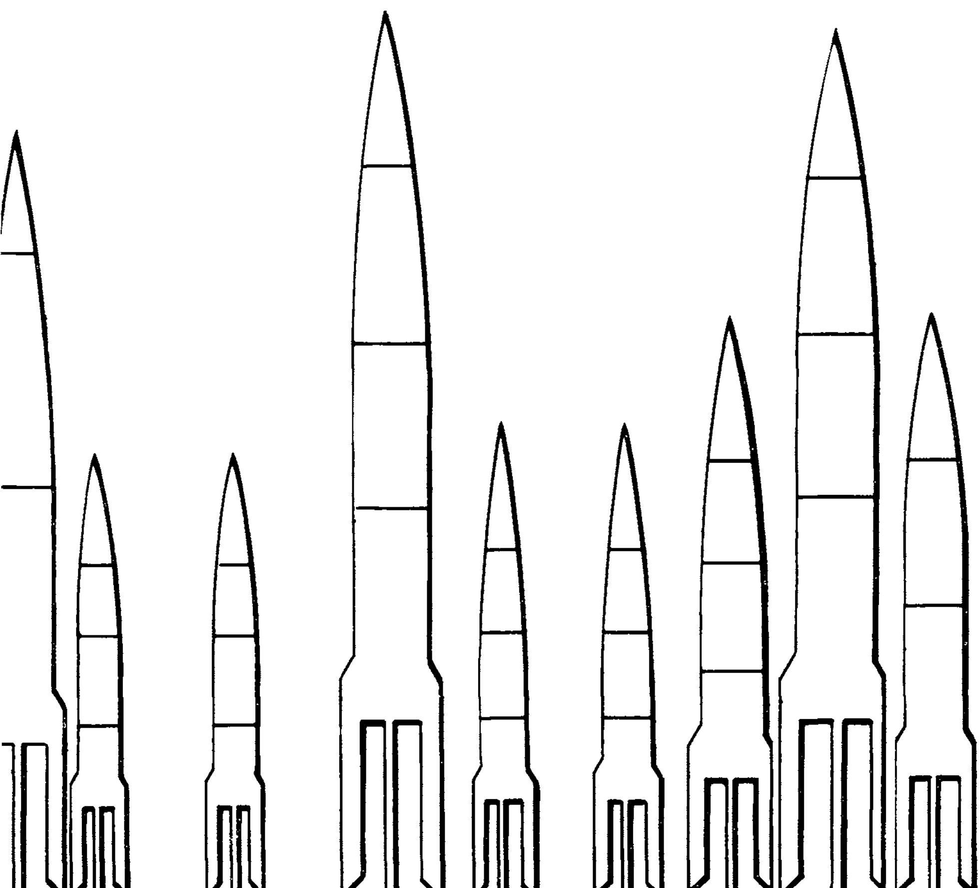
Figure 1. US and Soviet strategic ballistic missiles

	US SLBMs			Soviet SLBMs			
	Polaris A-3	Poseidon C-3	Poseidon C-4	SS-N-5	SS-N-6	SS-N-8	SS-N-18
Date introduced	1964	1970	–	1963	1968	1973	–
Number deployed (estimates for Sep 1979)	160	496	0	21	528	354	64
Number of MIRVs	3 (MRV)	10–14	~8	1	1 (or 2 MRV)	1	3
Range (nautical miles)	2 500	2 500	4 000	700	1 300–1 600	4 300	4 000
Propellant	s	s	s	l-st	l-st	l-st	l-st
Throw-weight (kg)	500	1 000		. .	700	700	
CEP (m)	900	550	500	3 700	1 800–2 800	1 500	1 000

Key: Propellant fuel: l = liquid, l-st = liquid-storable, s = solid, st = storable.



US ICBMs			Soviet ICBMs					
Titan II	Minuteman II	Minuteman III	SS-9	SS-11	SS-13	SS-17	SS-18	SS-19
963	1966	1970	1966	1966	1969	1977	1976	1976
54	450	550	102	620	60	100	206	310
1	1	3	1	1 (or 3 MRV)	1	4	1 or 8	6
6 300	7 000	7 000	6 500	5 700	4 400	5 000	5 500	5 000
	s	s	l	st	s	l-st	l-st	l-st
4 000	1 000	1 000	7 300	1 000	500	3 200	7 300	3 200
900	550	350	900–1 300	900–1 300	1 300	600	450–600	450



are more likely to increase the possibility of nuclear world war than are increases in numbers of nuclear warheads—these numbers are now so huge that further increases have no military or strategic significance.

Both the USA and USSR are making qualitative improvements to their nuclear weapons. In the USA, for example, the deployment of the Mark 12A warheads for the US Minuteman III will begin in October 1979. The accuracy of Minuteman III is being improved by the installation of the NS-20 guidance system, which will reduce the circular error probability[2] (CEP) from about 350 m to about 200 m. Such accuracy, coupled with a warhead more than twice as powerful as that of the current Minuteman III, will then be much better able to destroy Soviet ICBMs in their hardened silos. The Mark 12A warhead with the NS-20 guidance system will, in fact, be able to destroy Soviet ICBMs in normal silos with a probability of nearly 60 per cent for one shot and about 95 per cent for two shots. The corresponding figures for the current Minuteman III (with the NS-20 guidance system) are 50 per cent and 80 per cent.

Future land-based mobile ICBMs may be particularly dangerous weapons. For example, the US M-X missile, a $40 thousand million weapon system, will probably carry about 10 manoeuvrable re-entry vehicles (MARVs). MARVs have terminal guidance,[3] which gives them CEPs of a few tens of metres, increasing counterforce capabilities still further.

One deployment scheme for the M-X missile is the Multiple Aim Point (MAP) deployment. Under MAP an ICBM would be moved between, and launched from any one of, many covered silos. The adversary would then have to attack all holes in order to be sure of knocking out the missile. To be effective against the Soviet ICBM force, the scheme would involve the use of literally many thousands of new holes. The environmental objections to MAP are clear. Another scheme under serious consideration is that M-X missiles should be carried on, and launched from, cargo aircraft. Because this missile is actually designed to avoid detection, and hence verification, it would seriously complicate the negotiation of future strategic arms limitation agreements.

Eventually, MARVs will probably also be deployed on SLBMs, such as the US Trident II missile under development for deployment in Trident nuclear submarines, to be equipped with 24 SLBMs each. SLBMs will then, for the first time, have indisputable hard-target capabilities.

[2] Circular Error Probability (CEP) is the radius of a circle, centred on the target, within which 50 per cent of the weapons or munitions aimed at the target will fall.

[3] Terminal guidance uses a system (for example a laser or radar) to guide the warhead, after re-entry into the Earth's atmosphere, onto its target.

The USA is now designing a dual-purpose missile which could be used in a three-stage version for the M-X missile or in a two-stage version for Trident II. Full-scale development of the missile is planned to start in mid-1979. The Trident programme is enormously expensive —each submarine will cost over $1 700 million and the total programme costs will probably exceed $30 thousand million. (The annual budget of the US Navy is about $41 thousand million.)

The USSR is also increasing the accuracy of its strategic nuclear warheads and has developed a mobile ICBM, the SS-X-16.[4] A mobile intermediate-range ballistic missile (the SS-20), armed with MIRVs, is already being deployed as a tactical nuclear weapon for use in, for example, Europe. At the beginning of 1979, about 120 SS-20 launchers had probably been deployed (the production rate appears to be about 50 per year). Each SS-20 missile carries three MIRVs, each with a yield of about 250 kilotons. The SS-20, a two-stage version of the SS-X-16, is much more accurate than older Soviet ICBMs, of which about 600 are deployed. According to US sources, a new generation of Soviet ICBMs for possible deployment in the 1980s is under development.

Counterforce

One consequence of the development of very accurate missile warheads is that counterforce—nuclear war-fighting—strategies are being increasingly emphasized to rationalize the deployment of new strategic weapons. For many years now, a large fraction—probably more than one-half—of the warheads in the nuclear arsenals have, in fact, been targeted on military targets (even though these may, in general, have been large-area targets). What is new is that missiles can be very rapidly re-targeted by such systems as the Command Data Buffer System. Whereas it used to take many hours to change the targeting information in the guidance systems of the missiles, this task can now be done in a very short time. High missile accuracy and fast re-targeting capability are necessary for nuclear war-fighting.

Even though many nuclear warheads were aimed at military targets, mutual assured destruction based on a countercity doctrine has been the official nuclear policy, at least in the USA. Moves to a counterforce strategy are being made not because the requirements of nuclear deterrence have changed (the psychology of the enemy is, after all, the same) but because counterforce weapons are being developed and deployed. Policies have to be adapted to justify this deployment.

[4] The USSR has agreed in SALT II not to deploy the SS-X-16 for verification purposes because it could be confused with the SS-20.

The change in official thinking about nuclear deterrence is indicated by some remarks made by US Secretary of Defense Harold Brown in his 1980 Annual Report of the Department of Defense:

> A strategy based on assured destruction alone no longer is wholly credible. . . . We now recognize that the strategic nuclear forces can deter only a relatively narrow range of contingencies, much smaller in range than was foreseen only 20 or 30 years ago. We also acknowledge that a strategy and a force structure designed only for assured destruction is not sufficient for our purposes. At the same time, we have to admit that we have not developed a plausible picture of the conflict we are trying to deter.
>
> To have a true countervailing strategy, our forces must be capable of covering, and being withheld from, a substantial list of targets. Cities cannot be excluded from such a list, not only because cities, population, and industry are closely linked, but also because it is essential at all times to retain the option to attack urban–industrial targets —both as a deterrent to attacks on our own cities and as the final retaliation if that particular deterrent should fail. The necessary forces should be included in whatever requirements we set for a strategic nuclear reserve following initial exchanges.
>
> The degree to which hard targets such as missile silos, command bunkers, and nuclear weapons storage sites need to be completely covered as part of the list is a more difficult issue [3].

This shows current US policy to be a hybrid—a rather confusing mixture of counterforce and countercity doctrines. But it can be expected that, as more accurate and reliable nuclear weapons are developed, US nuclear policies will become increasingly based on counterforce thinking. As far as is known, Soviet nuclear strategy may emphasize counterforce more than that of the USA, even though Soviet missiles are less accurate and reliable than their US counterparts. As the quality of Soviet missiles increases, so the counterforce doctrine will probably become more refined. The more the two great powers adapt to counterforce nuclear doctrines the greater the probability of a nuclear world war will become.

In a nuclear world war most nuclear weapons would fall in the Northern Hemisphere in which there are no more than 400 cities large enough to 'justify' a nuclear warhead. In fact, sufficient warheads are carried by just one modern US Poseidon nuclear strategic submarine to obliterate every Soviet city with a population greater than about 150 000. (These cities contain a total of about one-third of the Soviet population.)

It is reasonable to suppose that about one-half of the strategic nuclear warheads, and many of the larger tactical nuclear weapons in the arsenals, are targeted on (or near) cities. On average, then, each city in the Northern Hemisphere would be blasted by the equivalent of say 13 million tonnes of TNT, the equivalent of about 1 000 Hiroshima bombs. These cities would be destroyed and the bulk of their inhabitants killed instantly. Many of the rural inhabitants would soon die from the effects of radioactive fallout, as would millions in the Southern Hemisphere.

Global climatic changes induced by such a war, damage to the ozone layer (the stratospheric shield which helps to protect life on Earth from excess ultraviolet radiation), and the long-term consequences of genetic damage done to the human race by the radiation from the resulting world-wide radioactive fallout are unpredictable. The long-term effects of a nuclear world war would be considerably more serious than short-term ones. The launching of such a war must, therefore, be considered an irrational act. This will, however, not necessarily prevent it.

We can now see that offensive and defensive strategic nuclear weapon systems may be developed which will make a first strike possible—or, in the opinion of some scientists, probable. In this context a first-strike capability does not mean the ability of one side to destroy totally the other side's ability to retaliate. It means that one side perceives that it has the capability of destroying enough of the other side's retaliatory forces so as to limit the casualties and damage it would suffer from a retaliatory strike to an 'acceptable' level for a given political goal. The more reckless the political and military leaders, the higher this level is likely to be.

ASW and the first-strike strategy

Progress is particularly apparent in the development of effective anti-submarine warfare (ASW) techniques. Success here would considerably increase the danger of a first strike, because about one-third of strategic nuclear forces are submarine-borne.

An enormous effort is being put into the development of ASW systems. Its magnitude will almost certainly lead, in time, to success. Success here does not necessarily require a technological breakthrough because steady progress in limiting the damage that can be done by hostile strategic nuclear submarines will eventually lead to a situation where a first strike may be perceived to be possible and even desirable. This will be particularly so when land-based ICBMs become vulnerable to a first strike by the enemy's land-based ICBMs. In a short time, nuclear strategic submarines may become as vulnerable as land-based ICBMs.

Current US ASW techniques could already seriously limit (although not completely remove) the damage which would be done by the Soviet strategic nuclear submarine fleet in a second strike. This fleet is, in any case, relatively disadvantaged by geography. Its exits to the Atlantic and the Pacific Oceans are restricted channels which can be relatively easily monitored by existing ASW equipment. Moreover, more Soviet submarines tend to stay in, or near, their ports than do their US counterparts. This could make them more liable to destruction.

Even though ASW weapons are being continually evolved, the critical element is detection. For quite some time now the destruction of submarines has been relatively easy once they are detected. Current developments in ASW surveillance include more sensitive sensors, increasing integration between various sensing systems, and improved processing of data from ASW sensors. As described in chapter 8, airborne, space-borne, ocean-surface, and sea-bottom sensing devices are becoming increasingly complementary and, therefore, more effective. There is also an increasing integration of ASW aircraft, surface ships and hunter–killer submarines. Each weapon system has characteristics which complement those of the other, and integration, therefore, leads to high effectiveness.

Command, control and communications

Effective command, control and communications (C3) would be essential in a modern nuclear war. But whereas a first-strike strategy emphasizes C3 capable of very rapidly handling large amounts of information, C3 for a second strike would be designed to survive the direct and indirect effects of a large nuclear attack. Survivability of C3 in a second strike is more important than speed of reaction. The indications are that recent C3 developments favour a first-strike rather than a second-strike strategy.

It should be pointed out, however, that the search for a C3 system—ground-based, airborne or space-borne—capable of surviving a large nuclear attack so that a retaliatory strike can be carried out, has so far been unsuccessful.

Nuclear explosions

Arms control negotiations have so far been so slow, however, that they are generally overtaken by advances in military technology. The drift towards first-strike capabilities and the increased probability of nuclear world war that this brings is a major danger. The best way of avoiding a nuclear world war is to get rid of nuclear weapons.

A comprehensive ban on nuclear weapon tests would be a real step towards halting the qualitative nuclear arms race. The need for such a ban is emphasized by the continuing high number of nuclear weapon tests (see tables of nuclear explosions in chapter 16).

According to preliminary estimates, 48 nuclear explosions were carried out in 1978: 27 by the USSR; 10 by the USA; 6 by France; 3 by

China; and 2 by the UK. The number of explosions carried out since 1945 has reached 1 165, the USA and the USSR being responsible for almost 90 per cent of them.

IV. Disarmament

The UN Special Session in 1978

Many had hoped that some progress towards disarmament would have been made at the United Nations General Assembly's Special Session devoted to Disarmament, which took place in New York between 23 May and 1 July 1978. The Special Session is analysed in chapter 11. Out of 149 UN member states, 126 addressed plenary sessions of the Special Session, the first disarmament conference involving almost all countries to be held for 47 years. Twenty of the speeches were made by Heads of State or Government and 49 by Foreign Ministers.

A Final Document, adopted by the General Assembly without a vote, restates the general principles and goals of disarmament already defined in UN resolutions adopted over the past 30 years. It also contains some new substantive elements. In the list of priorities for disarmament negotiations, for example, conventional disarmament is dealt with in parallel to nuclear disarmament. Non-nuclear disarmament measures had previously been considered by most states mainly within the framework of general and complete disarmament. This is an important change of approach, because conventional armaments account for the bulk of world military expenditures. Moreover, the very possession of nuclear weapons has been justified by a perceived need to deter aggression started with conventional weapons.

The Final Document also calls for limitation of the international transfer of conventional weapons and recommends that major arms supplier and recipient countries should conduct consultations on this subject. This recommendation, never before made by the United Nations, is significant because many Third World countries are usually suspicious of any proposals aimed at restricting their arms supplies. The Final Document also deals with the so-called negative security guarantees to prevent the use or threat of use of nuclear weapons against non-nuclear weapon states. Noting the unilateral non-use declarations made during the Session, it urges the conclusion of effective arrangements.

During the Special Session there was much support for the Nordic proposal for a study of the relationship between disarmament and development. The Programme of Action asks the Secretary-General, with the assistance of a group of qualified governmental experts appointed by him, to initiate an expert study on the subject. This has been done.

The importance of mobilizing public opinion in favour of disarmament was recognized. Governments and governmental and non-governmental international organizations were urged to take steps to develop educational programmes for disarmament and peace studies at all levels. It was also decided to establish a programme of UN fellowships in disarmament.

The main achievement of the Special Session was the establishment of a new negotiating body, to replace the Conference of the Committee on Disarmament (CCD) which has been meeting since March 1962 in Geneva. It is called the Committee on Disarmament (CD) and is open to the five nuclear weapon states and 35 other states. The CD was convened in Geneva on 24 January 1979. The chairmanship of the CD will rotate among all its members on a monthly basis. France is participating in the new Committee and China may at some time do so. Neither of these two nuclear weapon powers attended the CCD.

The Special Session did not contribute to the solution of the most essential problems of the arms race. The USA and the USSR were unable to report a SALT agreement. The expected treaty on the cessation of all nuclear weapon tests had not materialized, nor had any progress been made in banning chemical weapons. On the question of non-proliferation of nuclear weapons, the Final Document is weaker than many UN resolutions adopted on the subject. There is no call for universal adherence to the Non-Proliferation Treaty, and excessive emphasis on peaceful uses of nuclear energy in the Final Document has distorted the arms control aspect of non-proliferation. Another deficiency of the Final Document is that it continues to deal with disarmament in a piecemeal manner.

A comprehensive disarmament programme is mentioned, but 'comprehensive' has not been defined, and the 'programme' itself remains to be developed. The basic differences of approach of individual states and political blocs have remained almost intact. They have merely been skilfully wrapped up in ambiguous phraseology, or sidetracked by frequent references to 'national security', disguising the continuing reluctance to subordinate short-term national considerations to longer-range global interests.

However, the Final Document can be regarded as a new comprehensive frame of reference for the negotiators. This is important because the reinforcement of the disarmament deliberative bodies and the reform of the negotiating machinery may stimulate the process of negotiations.

An important accomplishment of the Special Session was that it helped non-governmental organizations (NGOs) to mobilize public opinion for the cause of disarmament. For the first time in UN history the representatives of these organizations, as well as research institutions (including SIPRI), could address the General Assembly on issues of universal importance. (The role of NGOs in disarmament is the subject of chapter 18.)

The regular session of the UN General Assembly which was held in the autumn of 1978 made a step forward in consolidating the framework for disarmament negotiations, and in setting in motion worldwide information and education activities in the field of disarmament. However, no progress was made as regards substantive issues, since a number of resolutions were not approved by states usually responsible for their implementation.

Other approaches to disarmament

The failure so far to achieve disarmament has led to renewed interest in other approaches to the problem of reducing the role of force in international affairs. One such approach is to prohibit or restrict the use of the more inhumane or indiscriminate conventional weapons. Chapters 9 and 14 are devoted to this issue.

On 7 December 1978, two protocols additional to the 1949 Geneva Conventions for the protection of war victims entered into force. The protocols constitute a step forward in the development of the humanitarian laws of war, even though some of their provisions lack clarity and certain definitions are imprecise. Their greatest shortcoming, however, is that they have not forbidden any specific weapon which is excessively injurious or has indiscriminate effects. The question of conventional weapons of a particularly cruel nature was discussed in detail during the Geneva Diplomatic Conference which drafted the texts of the protocols, but it has not been resolved. Further attempts to prohibit or restrict the use of certain conventional weapons, which may be deemed to be excessively injurious or to have indiscriminate effects, will be made at a special UN Conference in September 1979.

The Conference will pay particular attention to the prohibition or restriction of the use of the following weapons: incendiary weapons; bullets which tumble or break up in the human body; multiple-projectile bullets; fuel–air explosives; fragmentation weapons within specified zones of inhabited areas; and mines which cannot be located and disposed of by known means.

Useful though these measures would be, attention should not be diverted from the fact that weapons of mass destruction are by far the greatest threat to our survival. Human creativity has shown itself extremely able in maximizing the use of technology for destructive purposes. The political and social institutions needed to control this technology have yet to be developed.

References

1. Myrdal, A., *The Game of Disarmament. How the United States and Russia Run the Arms Race* (Pantheon Books, New York, 1976).
2. Brandt, W., A Balance between North and South, paper delivered to the Discussion Group on Economic Affairs and Politics at the Friedrich-Ebert-Stiftung, 20 September 1978.
3. *Department of Defense Annual Report for Fiscal Year 1980*, Secretary of Defense Harold Brown (US Department of Defense, Washington, D.C., January 1979).

1. World military expenditure

Square-bracketed numbers, thus [1], *refer to the list of references on page 32.*

I. Introduction

The object of the SIPRI collection of military expenditure figures is *not* to compare the military strength of one country with another or one group of countries with another. For many reasons (discussed below), military expenditure figures are not suitable for this purpose—and indeed (as also discussed below), when such figures are brought into the debate about relative military strengths, they are frequently misused. The purpose of the figures presented here is, first, to look at the economic burden which military preparations impose on different countries and on the world—to provide some measure of the resources consumed and consequently of the civil opportunities forgone. Secondly, the figures can provide warning signals. Sharp increases in military expenditure in some areas, persisting over a number of years, give the same sort of warning as the warning given by the big rise in military expenditure in Europe which preceded World War I.

The main event in 1978 is one which seems likely to alter the future trend of world military expenditure in a dangerous way. A number of NATO countries have begun to put into effect the decisions taken in May 1977, and confirmed in May 1978, that they should if possible begin to raise their military spending by 3 per cent per year in real terms. The signs are already there in the military budgets of the main NATO countries for future fiscal years. In the US budget for 1979/80, the rise in outlays on *total* military spending (and not just on spending linked to NATO) is put at 9.9 per cent. If we assume that the rate of inflation comes down by 1 per cent from the 1978 year-over-year figure of 7.8 per cent—and this is not an unreasonable assumption—then this figure implies a 3 per cent rise in real terms. The Budget has, of course, to go through Congress; the changes are unlikely to be so substantial as to alter this 3 per cent figure significantly. The United Kingdom Public Expenditure White Paper also includes a 3 per cent real rise for military spending in the fiscal year 1979/80. The French military budget for 1979 shows a 14 per cent rise in money terms, which is unlikely to produce anything less than 3 per cent in real terms. In the Federal Republic of Germany, where prices now are virtually stationary, the 1979 Budget indicates a 3 per cent rise. Altogether we must now expect that NATO military expenditure, which has been running roughly flat for the past five years, will begin to move up again.

The NATO claim is, of course, that it is responding to a long-term upward trend in real military spending in the Soviet Union. NATO publications, with a noticeably casual use of figures, have sometimes put this trend at "about 5 per cent", and sometimes at "3-5 per cent". This was over a period when, NATO claims, the trend in NATO expenditure has been flat. For reasons given below, the validity of the comparison of the two trends is doubtful because they are calculated in very different ways. In any case, there has been the expected response at a Warsaw Treaty Organization (WTO) meeting in November 1978. Figures of intended increases have not been given on the WTO side, except by the German Democratic Republic, which has announced its intention of raising military expenditure by 5 per cent in real terms. Romania, however, has indicated that it has no intention of increasing military expenditure, both for economic reasons and also because it does not judge that the situation in Europe warrants any such increase. Poland has also announced a military budget showing no increase in real terms; here the justification for the decision was economic. However, for the WTO as a whole, some acceleration in the rate of increase in military expenditure (in real terms) must from now on be expected.

It seems therefore that we are on the verge of an intensification of the arms race in Europe, with significant impending rises in military expenditure. This is really rather a remarkable development, given that this is happening when all the major post-war controversies between the two sides appear to have been settled, with the acceptance of the fact of two Germanies, and when all European countries have solemnly declared at Helsinki that they have no desire to change the European status quo. In this respect, the contrast between the position now and the position in the 1930s—when there was one powerful nation explicitly declaring its intention of changing the map of Europe, and indicating its readiness to use force to bring those changes about—could hardly be more marked. There are strong forces which can push up military expenditure even when there is nothing in the international political situation to warrant any increase—indeed, when on any reasonable assessment one might expect a reduction.

II. The trend to date[1]

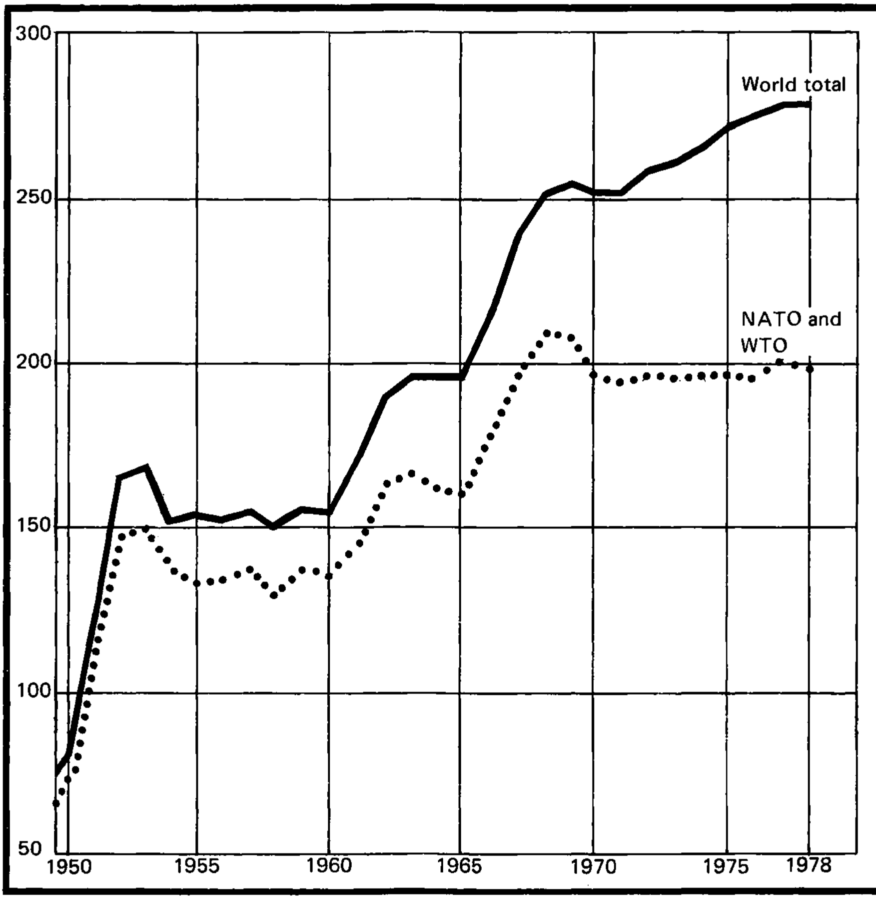
The world, NATO, WTO and Europe

On the SIPRI estimate, the total of world military expenditure has continued to move up by rather over 1 per cent a year during the past

[1] All trend figures are given in real terms—that is, corrected for price changes—unless otherwise stated.

Figure 1.1. The trend in world military expenditure, 1949–78

The values are US $ thousand million, at constant (1973) prices and 1973 exchange rates.



decade. For 1978, it seems that world military spending was roughly the same as in 1977. However, the 1978 figure is highly provisional. A pattern has emerged by which world military spending rises sharply at times of major conflict (the Korean War, the Viet Nam War), but then does not fall back again; there is a ratchet effect. The trend shown in figure 1.1 is based on a series measured in 1973 dollars; in current dollars, the SIPRI world estimate for 1978[2] is about $400 thousand million.

Up to 1968, it could be said that the world trend followed very closely that of NATO and the WTO combined (figure 1.1). They still, in 1978, account for some 70 per cent of the world total. However, from 1968

[2] In 1978 the value of the dollar fell sharply against most other currencies.

onwards the military spending of the two great power blocs (taken together) has been running roughly flat, while total world military spending has continued to rise. This is mainly because of the very big increase in military spending in the Middle East, and to a lesser extent in the Far East and Africa.

Over the past five years, NATO expenditure in total has stayed about the same—it has been coming down in the United States and rising at the rate of about 2 per cent a year in NATO Europe. It is a much more controversial matter to say what the comparable level, and trend, have been on the WTO side. The difference between the various figures which are available is enormous. On the one hand, if one accepts the official Soviet figure in roubles and converts it into dollars at the current official exchange rate, a figure is obtained for Soviet military expenditure of $25 thousand million in 1978, which is less than a quarter of the figure for the United States. Further, the official figures show a slight falling trend since 1970, with the 1978 figures some 4 per cent below the 1970 one. At the other extreme, the US Central Intelligence Agency (CIA) estimate of Soviet military expenditure valued at US prices produces a figure for 1978 which, at about $146 thousand million, is said by the CIA to be about 45 per cent higher than the comparable US outlay. Further, the CIA say that from 1967 to 1978 Soviet military spending was rising at an annual rate of 3 per cent.

It seems wholly improbable that the resources which the Soviet Union devotes to military purposes amount to only one quarter of those of the United States. Further, it is hard to believe that the increases which, it is generally agreed, did occur in Soviet weaponry during the past eight years were accommodated within a falling budget. On the other hand, the CIA estimate of the cost of the Soviet military effort valued at US prices is regarded by SIPRI as being a wholly misleading figure for virtually any purpose (page 28), and the CIA method of assessing the Soviet trend is considered to be one which exaggerates it, in comparison with the different method used for calculating real trends in the West. The compromise figure for Soviet military expenditure used in the compilation of the world table has, of course, a very large margin of error. If the Soviet Union is interested in restraining the speculations about the size of its military budget which intensify arms races, it should provide more information on this matter beyond the single 17-word entry in the Soviet Budget.

It appears on the SIPRI figures that in both NATO and the WTO there has been some tendency for a larger share of the burden to be borne by the junior partners of the alliance. The military spending of WTO countries other than the Soviet Union appears to have been rising some 5 per cent a year since 1973. However, their share of WTO military expenditure, although it has risen from the 1968 figure of 9 per cent, still seems to be only about 11 per cent of the total. NATO Europe, on the other hand, now accounts for some 40 per cent of total NATO military spending (against 25 per cent in 1968). The United States has also been putting some pressure on Japan to increase its military spending—and this Japan has been doing (see below).

There is always a certain interest in observing—as another possible indicator of incipient danger in Europe—the trend of military expenditure in those European countries which are not members of either NATO or the WTO. Their aggregate military expenditure has shown an upward trend over the years at about 3 per cent. However, for the years 1976 and 1977 taken together, possibly in the aftermath of the Helsinki Conference of 1975, military expenditure in this group of countries did not rise at all. In 1978 the trend rise of around 3 per cent was resumed.

Trends in the rest of the world

The two areas outside Europe where the trend of military expenditure is most disturbing are Africa and the Far East. In Africa (which in this presentation includes the whole of the continent except Egypt) military expenditure was rising 8 per cent a year in the five years up to 1973; in the five years since then, the annual increase on the SIPRI calculations has been no less than 15 per cent. For the continent as a whole, military spending must be taking a rapidly increasing share of the national product. If full information about the resources which have been employed in the conflicts in Rhodesia and Ethiopia were available, the figure would probably be higher. South Africa's military spending is the largest single component of the total—and South Africa has been increasing its military budget by 25 per cent a year over the past five years. The tendency to push up military spending has been particularly noticeable in East Africa: Kenya more than doubled its expenditure between 1976 and 1978, and Zambia increased it threefold between 1975 and 1977. In West Africa there have not been the same startling increases.

In the Far East, there are no good estimates of military spending in recent years for Viet Nam, Laos or Democratic Kampuchea. If one takes the Far Eastern area excluding those countries and excluding China, there is an upward trend over the past decade of 8 per cent per year. South Korea and Taiwan have both been pushing up their military budgets sharply in recent years; this is no doubt partly because of the impending US withdrawal.[3] Military spending in Japan has also been on

[3] There have also been big increases in the past two years in Malaysia, Indonesia and the Philippines.

a strong upward trend for a long time—an average 6 per cent rise a year over the past decade. The increase was below trend between 1973 and 1977; however, in 1978 it went back to the long-term 6 per cent trend, and a similar rate of increase is expected in the coming fiscal year. Japan can no longer be regarded as a country whose military effort is negligible; although the share of national product devoted to military spending is still very low, its total military budget is now comparable to that of, say, Italy.

The picture of military expenditure in China is even more opaque than that of the Soviet Union. The Soviet Union at least publishes one figure; China publishes none. We have in this *Yearbook* accepted the view put forward in the figures published by the US Arms Control and Disarmament Agency—that military expenditure in China has been rising at about 3 per cent a year. Given China's determination now to acquire modern weapons, the rate of increase in future may be faster.

Up to 1976, the Middle East was the area of the world where military expenditure was rising fastest; indeed, from 1968 to 1976 the rate of increase was 22 per cent a year. In the past two years there has been a sharp change, and spending has fallen by about a quarter from the 1976 high point. This is not only because Egypt and Israel have been spending less. Military spending in Iran seems to have come down as well, again from a very high figure, and in Saudi Arabia the long-term rapid increase has at last been checked. The oil-rich countries of the Middle East were probably unable to increase their annual absorption of military hardware even further. The figures for only two years do not, of course, make a trend, and by 1976 aggregate military budgets in the Middle East had reached an enormous total—about equal to the whole of the Far East (excluding China), South Asia, Africa, Central America and South America put together.

In the rest of the underdeveloped world, the trends are less dramatic. In South Asia (India and Pakistan), there is a pretty steady upward trend of about 4 per cent a year. In South America, military spending had been rising fast up to 1973; then it was flat for four years. Preliminary estimates for 1978 suggest that it then started to rise again quite sharply, with a particularly big increase in Chilean military spending. In Central America, which used to be an area where military spending moved very little, there are now some signs of an acceleration—from a 2 per cent trend in the five years before 1973 to a 4 per cent trend since then.

The one area of the world outside the NATO – WTO arena where there has been no upward trend at all in military expenditure during the past decade is Oceania (which is, for all intents and purposes, Australia and New Zealand). There the 1978 estimated figure was virtually the same as in 1968.

III. The misuse of military expenditure figures

The essentially curious fact is noted above that we appear to be on the verge of an increase in the already enormous military expenditure figures in Europe, in spite of the fact that there are no major issues between the two sides in Europe. Here we are concerned with only part of the story of how this has come about—the story of a successful propaganda exercise.

It is, of course, only to be expected that the institutions which are engaged in military activities will use every argument and every form of pressure available to them to persuade governments that they should be given more resources. All bureaucracies do this; it could hardly be expected that the military bureaucracy would be an exception—and to say that they do this is not to suggest that they are more reprehensible than the education lobby, or the health expenditure lobby, for example. However, the military are in a peculiarly powerful position in this process of exerting pressure, in that they have almost exclusive possession of the information which can be used to justify their demands. It is the military sector which collects the information about 'the threat' which it can use to justify its own demand for more resources. No other pressure group is in such a powerful position. The outsider who studies military presentations may wonder whether there may not be some bias in the presentation; he is, however, in a very weak position. He has no independent access to the information about a potential enemy's military power, and he is also under the additional handicap that, as a critic of military demands, he may well find himself labelled as unpatriotic.[4]

We know only a very small part of the story of the way in which pressure is brought to bear for increases in military expenditure. Nothing is published about this in the Soviet Union; any debate which there may be about the relative priority of civil or military demands is conducted behind closed doors. We do know something about the 'presentation of the threat' in NATO countries, particularly in the United States. This section looks in particular at the way in which certain propositions have been put forward about Soviet military expenditure. Because some of the issues involved are technical economic issues, it is possible here for the outsider to express a critical judgement. The conclusion is that there is a clear bias in the presentation of this material. It is inevitable, and unfortunate, that this criticism appears one-sided, because the arguments and propositions put forward by the military

[4] "There can be few more seemingly unequal political contests in the world than those over military spending, its claims against social needs. On the one side, powerful military bureaucracies, influential and richly financed weapons industries . . . On the other side, only reason, the will to survive, the inarticulate poor." [1]

sector in Western countries are at least to some extent in the open record.

The presentation of estimates of Soviet military expenditure

Many political commentators in NATO countries now treat as 'known facts' the following propositions about Soviet military expenditure—propositions which NATO military spokesmen have been intensively repeating. The first proposition is that Soviet military expenditure now exceeds that of the United States. The second is that military expenditure takes a much larger share than it used to do of Soviet gross national product, and that that share is a very high one. The third proposition is that Soviet military expenditure has, over a long period, been rising in real terms by at least 3 per cent a year, while military expenditure in NATO countries has not been rising at all. These propositions have been extensively and successfully used in the campaign to persuade NATO governments to plan increases in their own military spending. These three propositions are not 'known facts'; they are highly questionable.

Let us take first the proposition that Soviet military expenditure exceeds that of the United States. Of course, this is not true of the figure which the Soviet Union itself produces for its own military expenditure—one single figure of 17.2 thousand million roubles with no further explanation. There is no exchange rate within the bounds of possibility which could convert this into a figure which exceeds the US figure for military expenditure of $105 thousand million at current prices. The United States intelligence agencies do not of course accept the Soviet figure. Their estimates of Soviet military expenditure are constructed in an entirely different way. They build up a large series of actual physical outputs, series constructed both from satellite photography and other intelligence sources, so that they have figures for the numbers in the Soviet Union's own forces, the output of tanks, of nuclear submarines, of firearms of every description, and so on. To produce their estimate of Soviet military expenditure in dollars, they ask what it would cost to reproduce this military effort in the United States. Thus the Soviet soldier is valued at the amount which it costs to pay and maintain a US soldier; US manufacturers are asked what they consider it would cost to reproduce the various items of Soviet weaponry, and so on. This is the procedure which produces an estimate of Soviet military expenditure, in dollars, which far exceeds that of the United States.

However, as it stands, on its own, this is well known to be an illegitimate method of international comparison. Whenever one country's output is valued at another country's prices, the value of that output gets exaggerated. This is because any country adjusts its pattern of production to use more of factors which are plentiful, and therefore cheap, and use less of factors which are scarce, and therefore expensive. A country where labour is cheap will produce labour-intensive products. If we then take these products and ask what it would cost to produce them in a country where labour is expensive, and capital is cheap, then we will get a very high figure. This phenomenon is common knowledge in international economic comparisons. If a comparison is needed between the output (or expenditure) of two countries A and B, the proper procedure is to value country A's output at country B's prices, and also to value country B's output at country A's prices, and then take some average of the two.

It is clear that valuing Soviet military output at US prices produces just this kind of distortion. For example, with an enormous conscript army which is paid very little, the Soviet armed forces can be profligate with the numbers of men they use. The United States uses about 75000 men to man its strategic nuclear deterrent; the defence intelligence agencies calculate that the Soviet Union has approximately five times that number of men assigned to roughly the same number of missiles, submarines and bombers. Large numbers of Soviet troops work on construction projects, or are assigned to the railways or work on military farms to produce food for army mess-halls. When the dollar cost of Soviet military expenditure is computed, these men are valued at the high wages paid to US servicemen. This is the main reason for the very high figure of Soviet military expenditure when valued at US prices. There is not much doubt that if it were possible to value US military expenditure at Soviet prices, which is the other half of a proper comparison between the two countries, then US military expenditure, valued in roubles, would exceed that of the Soviet Union. The United States relies on a great deal of extremely sophisticated equipment; the rouble cost of duplicating that equipment would be very high indeed. The statement made by the CIA—that, when they 'very roughly' attempt to make the comparison in roubles, Soviet expenditure still exceeds that of the United States—is not credible. It is not credible because when the comparison is made between any other forms of expenditure in the two countries—health expenditure, education expenditure, or the national product as a whole—the difference between the dollar-based and rouble-based estimates is very big.

There is no doubt that the process of valuing Soviet military output at US prices is, by itself, a wholly invalid procedure for making any sensible comparison of US and Soviet military effort. Yet this invalid procedure is the basis of the statement, which is widespread among political commentators in Western countries, that it is a 'known fact' that Soviet military expenditure exceeds that of the United States.

The second example of the misuse of military expenditure calculations arises from the upward revision, by the US military intelligence services, of their calculation of the share of military expenditure in Soviet gross national product. Up to 1975, the figure given was 6–8 per cent of GNP. One of the assumptions of this calculation was that the military procurement sector was much more efficient than the civil sector, and that consequently the price or cost of military equipment in the Soviet Union, in relation to the price of civil engineering goods, was relatively low. Since 1976, the US intelligence agencies have changed this assumption, and have decided that the rouble prices of Soviet military material were more than twice as high as they previously assumed. They now say that Soviet military expenditure is 11–12 per cent of GNP, or even more. This does not in any way imply any upward revision of their estimate of the Soviet military effort; it is the same bundle of defence goods, but with higher prices put on them. The change results from a new assumption, that the military procurement sector is not as highly productive as was previously assumed [2].

This change clearly implies that the Soviet Union is economically weaker, not stronger, than was previously thought. Its military effort is more resource-consuming, and more costly, than the earlier estimates suggested, with a less efficient productive apparatus. Consequently the burden of supporting this large military force on the Soviet economy is greater than was previously thought. Yet commentator after commentator has used the new figures as if they imply that the Soviet threat was much greater than had previously been assumed. The most extreme example is perhaps that of Lt. Gen. Daniel O. Graham (Ret.), former director of the Defense Intelligence Agency, who produced an even larger figure for the share of Soviet military spending in GNP, of 20 per cent, and wrote: "The Soviets are spending twenty per cent of their GNP on their armed forces and civil defence; Adolf Hitler's Germany was spending somewhat less—fifteen per cent of GNP—for armaments just prior to the outbreak of World War II. Can the United States continue to deter the growing military threat with a grudging 5.4 per cent outlay on defence?" [3] The quotation shows this curious inability to comprehend that, if country A, using 5.5 per cent of its GNP, is able to match the military effort of country B, which needs 20 per cent of its GNP for the same purpose, it is country A which is in the far better position.

The third dubious proposition is the one that military expenditure has been rising fairly fast in the Soviet Union, in real terms, whereas in the United States and other NATO countries in general it has not. The assumption is dubious because the way in which the trend is estimated for the Soviet Union is different from the way in which the trend is estimated for NATO countries. For the Soviet Union, as explained above, the US intelligence agencies make a laborious and detailed product-by-product compilation of Soviet military output. This type of compilation will enable them to make full allowance for 'product improvement'—for the fact that a new weapon has a number of advances over an old one, for example. All product improvements of this kind will be counted as real increases. It is a method which allows, and indeed encourages, the estimators to make full allowance in their calculations for quality changes. There is nothing wrong with making an estimate of the trend in this way—indeed it may well be the best method, but it is a method which should be used for both sides.

However, the estimates of the trend of real expenditure for NATO countries are made in a different way. They consist of a series of money expenditure figures, deflated by price indices. It is a well-known characteristic of price indices that they tend to make insufficient allowance for improvements in quality. To take a civilian example, the price index for television sets will be based on the price of a certain size of set in the shops, and the constructors of the price index will not in general make proper allowance for improvement in the quality of the picture, or the durability of the tube, or other changes which make maintenance less frequent or less expensive. Because price indices do not properly allow for quality changes in this way, they in general tend to exaggerate the 'true' rise in prices, and consequently when they are used to deflate a series of money expenditure figures, they tend to produce too low a figure for the volume increase. If, in NATO countries, estimates of the trend in their own military expenditure were made in the same way as the estimates for the Soviet Union—that is, building up laborious product-by-product output series, with full allowance for quality changes or product improvement—then it is very possible that the 'real' series for military expenditure in NATO would show a rising trend as well.

Here, then, we have three examples of the way in which statements about comparative military expenditure which are highly dubious have been used as part of the military sector's pressure campaign to increase their share of resources. Propositions have been put forward as 'known facts' which are not known facts at all. Some of those who put forward these propositions knew how dubious they were; most of the 'secondary users' simply accepted them, and they have become part of the standard doctrine.

This is, of course, a study of only a very small part of the way in which the military case is stated; it just happens to be an area where some outside critical judgement is possible. It is one more example of the way in which the Soviet obsession with secrecy works to their disadvantage. These misleading analyses of Soviet military expenditure are possible only because the Soviet Union practises virtually total concealment. The constant repetition of the proposition that the single official figure should be used, with the official exchange rate, is totally unhelpful. If exaggerated estimates of Soviet military expenditure are propagated in the Western media, the Soviet Union has only itself to blame.

References

1. Galbraith, J.K., in *World Military and Social Expenditures*, ed. R.L. Sivard (WMSE Publications, Leesburg, Virginia, March 1978), p. 3.
2. *Allocation of Resources in the Soviet Union and China—1977*, Part 3, US Congress, Joint Economic Committee (US Government Printing Office, Washington, D.C., 1977), p. 17.
3. Graham, D.O., 'The Soviet military budget controversy', *Air Force Magazine,* May 1976, p. 33.

Appendix 1A

World military expenditure, 1978

For the sources and methods for the world military expenditure data, see appendix 1B. For the conventions used in the tables, see page 64.

Table 1A.1. World summary: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
USA	69 622	70 004	68 130	70 937	76 943	75 824	73 326	72 928	86 993	100 363
Other NATO	27 301	29 830	31 050	32 241	35 397	36 697	37 241	37 157	37 325	38 980
Total NATO	**96 923**	**99 834**	**99 180**	**103 178**	**112 340**	**112 521**	**110 567**	**110 085**	**124 318**	**139 343**
USSR	30 500	33 000	32 700	40 800	44 600	48 900	46 700	44 900	47 000	51 000
Other WTO	2 780	2 900	2 781	3 051	3 962	4 239	4 213	4 308	4 445	4 623
Total WTO	**33 280**	**35 900**	**35 481**	**43 851**	**48 562**	**53 139**	**50 913**	**49 208**	**51 445**	**55 623**
Other Europe	3 225	3 300	3 300	3 546	3 867	3 999	4 226	4 256	4 422	4 420
Middle East	1 225	1 325	1 340	1 450	1 620	1 810	2 090	2 400	2 875	3 735
South Asia	1 100	1 075	1 090	1 150	1 494	2 317	2 287	2 364	2 313	2 101
Far East (excl China)	3 100	3 300	3 400	3 550	3 783	3 977	4 304	4 838	4 929	5 442
China	[8 000]	[8 900]	[8 900]	[10 500]	[12 200]	[13 800]	[16 400]	[17 300]	[19 400]	[20 900
Oceania	976	1 024	1 018	1 006	1 039	1 166	1 356	1 559	1 779	1 937
Africa (excl Egypt)	275	325	390	575	855	967	1 163	1 338	1 397	1 635
Central America	375	400	435	458	512	548	583	574	617	663
South America	2 060	1 700	1 725	1 680	1 727	1 810	1 793	2 193	2 179	2 614
World total	**150 539**	**157 083**	**156 259**	**170 944**	**187 999**	**196 054**	**195 682**	**196 115**	**215 674**	**238 413**

Table 1A.2. NATO: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
North America:										
Canada	2 703	2 524	2 512	2 584	2 689	2 502	2 604	2 325	2 386	2 562
USA	69 622	70 004	68 130	70 937	76 943	75 824	73 326	72 928	86 993	100 363
Europe:										
Belgium	799	807	824	834	888	920	981	957	977	1 019
Denmark	370	361	404	411	502	508	524	556	548	547
France	7 321	7 469	7 699	7 935	8 229	8 087	8 311	8 446	8 688	9 155
FR Germany	4 141	6 611	7 148	7 535	9 562	10 749	10 301	10 180	9 869	10 264
Greece	242	251	266	258	262	268	279	302	327	422
Italy	2 033	2 121	2 204	2 279	2 500	2 787	2 853	2 961	3 204	3 128
Luxembourg	17	16	10	11	14	13	17	17	17	14
Netherlands	1 190	1 060	1 168	1 360	1 447	1 466	1 595	1 554	1 515	1 677
Norway	348	368	350	381	421	438	444	515	512	528
Portugal	229	257	266	427	485	474	517	517	545	669
Turkey	387	445	469	506	532	541	585	621	603	608
UK	7 521	7 530	7 730	7 720	7 866	7 944	8 230	8 206	8 134	8 387
Total NATO	**96 923**	**99 834**	**99 180**	**103 178**	**112 340**	**112 521**	**110 567**	**110 085**	**124 318**	**139 343**
Total NATO (excl USA)	**27 301**	**29 830**	**31 050**	**32 241**	**35 397**	**36 697**	**37 241**	**37 157**	**37 325**	**38 980**
Total NATO Europe	**24 598**	**27 306**	**28 538**	**29 657**	**32 708**	**34 195**	**34 637**	**34 832**	**34 939**	**36 418**

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
103 077	98 698	89 065	82 111	82 469	78 358	77 383	75 068	71 022	73 966	71 475	*100 928*
37 795	37 633	38 381	40 412	42 619	43 326	44 577	45 683	46 642	47 281	47 937	*68 520*
140 872	**136 331**	**127 446**	**122 523**	**125 088**	**121 684**	**121 960**	**120 751**	**117 664**	**121 247**	**119 412**	*169 448*
58 000	62 000	63 000	64 000	65 000	66 000	67 000	68 000	69 000	70 000	71 000	*70 000*
5 396	5 796	6 158	6 537	6 678	7 025	7 378	7 808	8 257	8 526	8 816	*10 669*
63 396	**67 796**	**69 158**	**70 537**	**71 678**	**73 025**	**74 378**	**75 808**	**77 257**	**78 526**	**79 816**	*80 669*
4 560	4 740	4 864	4 983	5 288	5 382	5 749	5 964	6 064	6 033	6 212	*9 269*
4 425	5 225	6 175	6 895	9 824	13 482	16 491	18 702	21 318	18 338	17 046	*31 903*
2 176	2 312	2 403	2 856	3 081	2 745	2 590	2 867	3 321	3 276	3 414	*4 290*
6 086	6 531	7 061	7 746	8 163	8 181	8 260	8 971	9 113	9 947	10 850	*15 908*
[21 800]	[23 800]	[25 800]	[27 100]	[26 100]	[26 200]	[26 600]	[27 400]	[27 500]	[28 350]	[29 200]	[*28 350*]
2 101	2 129	2 125	2 125	2 131	2 102	2 177	2 174	2 186	2 178	2 048	*2 853*
1 828	2 133	2 307	2 391	2 480	2 674	3 269	3 764	4 622	5 407	5 461	*8 444*
742	724	761	783	799	826	839	978	1 052	1 065	1 017	*1 262*
2 549	2 662	2 807	3 296	3 379	3 872	3 789	3 993	4 000	4 141	4 472	*4 718*
250 535	**254 383**	**250 907**	**251 235**	**258 011**	**260 173**	**266 102**	**271 372**	**274 097**	**278 508**	**278 948**	*357 114*

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
2 415	2 276	2 392	2 403	2 409	2 408	2 582	2 546	2 718	2 893	2 959	*3 921*
103 077	98 698	89 065	82 111	82 469	78 358	77 383	75 068	71 022	73 966	71 475	*100 928*
1 055	1 062	1 132	1 152	1 215	1 259	1 311	1 417	1 512	1 551	1 644	*2 597*
584	574	563	617	613	583	638	693	683	686	702	*1 097*
9 164	8 738	8 835	8 947	9 173	9 513	9 471	9 888	10 353	10 854	11 275	*15 200*
9 112	9 992	10 108	10 823	11 576	12 027	12 558	12 496	12 378	12 299	12 680	*17 991*
492	557	603	638	680	679	650	1 043	(1 022)	(1 230)	(1 230)	(*1 815*)
3 187	3 124	3 293	3 726	4 114	4 107	4 110	3 825	3 807	4 040	4 152	*5 191*
12	12	13	13	14	15	17	18	19	19	21	*30*
1 659	1 732	1 788	1 871	1 933	1 967	2 053	2 158	2 140	2 376	2 309	*3 910*
559	590	592	607	606	611	627	681	697	711	750	*1 150*
705	653	714	747	737	681	816	561	439	415	430	*568*
643	631	675	790	821	862	943	(1 563)	(1 916)	(1 606)	(1 127)	(*2 650*)
8 208	7 692	7 673	8 078	8 728	8 614	8 801	8 794	8 958	8 601	8 658	*12 400*
140 872	**136 331**	**127 446**	**122 523**	**125 088**	**121 684**	**121 960**	**120 751**	**117 664**	**121 247**	**119 412**	*169 448*
37 795	**37 633**	**38 381**	**40 412**	**42 619**	**43 326**	**44 577**	**45 683**	**46 642**	**47 281**	**47 937**	*68 520*
35 380	**35 357**	**35 989**	**38 009**	**40 210**	**40 918**	**41 995**	**43 137**	**43 924**	**44 388**	**44 978**	*64 599*

Table 1A.3. NATO: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
North America:										
Canada	*mn dollars*	1 740	1 642	1 654	1 716	1 810	1 712	1 813	1 659	1 766
USA	*mn dollars*	45 096	45 833	45 380	47 808	52 398	52 295	51 213	51 827	63 572
Europe:										
Belgium	*mn francs*	19 254	19 658	20 209	20 641	22 341	23 596	26 241	26 606	28 169
Denmark	*mn kroner*	988	986	1 113	1 180	1 551	1 651	1 764	1 974	2 080
France	*mn francs*	16 569	17 926	19 162	20 395	22 184	22 849	24 280	25 300	26 732
FR Germany	*mn marks*	6 853	11 087	12 115	13 175	17 233	19 924	19 553	19 915	20 254
Greece	*mn drachmas*	4 469	4 735	5 110	5 034	5 102	5 385	5 647	6 290	7 168
Italy	*thous mn lire*	647	667	710	749	861	1 031	1 118	1 212	1 342
Luxembourg	*mn francs*	429	402	263	290	355	348	462	477	497
Netherlands	*mn guilders*	1 656	1 505	1 728	2 013	2 186	2 307	2 661	2 714	2 790
Norway	*mn kroner*	1 024	1 107	1 058	1 179	1 371	1 465	1 570	1 897	1 947
Portugal	*mn escudos*	2 485	2 820	3 023	4 922	5 744	5 724	6 451	6 680	7 393
Turkey	*mn lire*	1 470	2 153	2 410	2 718	2 980	3 157	3 443	3 821	3 996
UK	*mn pounds*	1 593	1 595	1 657	1 709	1 814	1 870	2 000	2 091	2 153

Table 1A.4. NATO: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
North America:									
Canada	*5.2*	*4.6*	*4.3*	*4.3*	*4.2*	*3.7*	*3.6*	*3.0*	*2.8*
USA	*10.0*	*9.4*	*8.9*	*9.0*	*9.2*	*8.7*	*8.0*	*7.5*	*8.4*
Europe:									
Belgium	*3.7*	*3.7*	*3.6*	*3.4*	*3.5*	*3.4*	*3.4*	*3.2*	*3.1*
Denmark	*2.9*	*2.6*	*2.7*	*2.6*	*3.0*	*3.0*	*2.8*	*2.8*	*2.7*
France	*6.8*	*6.6*	*6.4*	*6.2*	*6.0*	*5.6*	*5.3*	*5.2*	*5.0*
FR Germany	*3.0*	*4.4*	*4.0*	*4.0*	*4.8*	*5.2*	*4.6*	*4.3*	*4.1*
Greece	*4.8*	*4.9*	*4.9*	*4.2*	*4.0*	*3.9*	*3.6*	*3.5*	*3.6*
Italy	*3.4*	*3.3*	*3.3*	*3.1*	*3.2*	*3.3*	*3.3*	*3.3*	*3.4*
Luxembourg	*1.9*	*1.8*	*1.0*	*1.2*	*1.3*	*1.2*	*1.4*	*1.4*	*1.4*
Netherlands	*4.7*	*4.0*	*4.1*	*4.5*	*4.5*	*4.4*	*4.3*	*3.9*	*3.7*
Norway	*3.5*	*3.6*	*3.2*	*3.3*	*3.6*	*3.5*	*3.4*	*3.7*	*3.5*
Portugal	*4.0*	*4.3*	*4.2*	*6.4*	*7.0*	*6.5*	*6.7*	*6.2*	*6.3*
Turkey	*3.8*	*4.5*	*5.1*	*5.5*	*5.1*	*4.7*	*4.8*	*5.0*	*4.4*
UK	*7.0*	*6.7*	*6.5*	*6.3*	*6.4*	*6.2*	*6.0*	*5.9*	*5.7*

Table 1A.5. WTO: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Bulgaria	156	147	161	195	232	267	234	207	216	222
Czechoslovakia	1 089	1 077	1 075	1 164	1 327	1 325	1 250	1 239	1 260	1 232
German DR	521	. .	316	316	853	884	916	979	1 011	1 137
Hungary	. .	127	157	171	249	330	313	292	264	275
Poland	602	768	801	914	987	1 102	1 152	1 212	1 300	1 345
Romania	288	276	271	291	314	331	348	379	394	412
USSR	30 500	33 000	32 700	40 800	44 600	48 900	46 700	44 900	47 000	51 000
Total WTO	**[33 280]**	**[35 900]**	**35 481**	**43 851**	**48 562**	**53 139**	**50 913**	**49 208**	**51 445**	**55 623**
Total WTO (excl USSR)	**[2 780]**	**[2 900]**	**2 781**	**3 051**	**3 962**	**4 239**	**4 213**	**4 308**	**4 445**	**4 623**

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1 965	1 927	1 899	2 061	2 131	2 238	2 405	2 862	3 127	3 589	4 124	4 597
75 448	80 732	81 443	77 854	74 862	77 639	78 358	85 906	90 948	91 013	100 928	105 135
30 396	32 319	33 754	37 388	39 670	44 140	48 941	57 395	69 936	81 444	89 480	99 008
2 249	2 591	2 640	2 757	3 195	3 386	3 520	4 439	5 281	5 680	6 343	7 135
28 912	30 264	30 696	32 672	34 907	37 992	42 284	47 878	55 873	63 899	73 530	83 414
21 408	19 310	21 577	22 573	25 450	28 720	31 908	35 644	37 589	38 922	40 184	42 588
9 390	11 003	12 762	14 208	15 480	17 211	19 866	24 126	43 917	(48 775)	(65 846)	(73 748)
1 359	1 403	1 412	1 562	1 852	2 162	2 392	2 852	3 104	3 608	4 533	5 223
413	374	391	416	442	517	601	710	836	983	1 029	1 160
3 200	3 280	3 682	3 968	4 466	4 974	5 465	6 254	7 246	7 817	9 260	9 367
2 097	2 300	2 502	2 774	3 022	3 239	3 505	3 938	4 771	5 333	5 934	6 756
9 575	10 692	10 779	12 538	14 699	16 046	16 736	25 108	19 898	18 845	22 082	26 111
4 596	5 159	5 395	6 237	8 487	9 961	12 192	15 831	(31 510)	(44 550)	(47 960)	(50 500)
2 276	2 332	2 303	2 444	2 815	3 258	3 512	4 160	5 165	6 132	6 822	7 492

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
2.9	*2.6*	*2.4*	*2.4*	*2.2*	*2.1*	*1.9*	*1.9*	*1.9*	*1.9*	*2.0*
9.4 |	*9.3*	*8.7*	*7.9*	*7.1*	*6.6*	*6.0*	*6.1*	*6.0*	*5.4*	*5.3*
3.1	*3.1*	*2.9*	*2.9*	*2.8*	*2.8*	*2.8*	*2.8*	*3.0*	*3.1*	*3.1*
2.7	*2.8*	*2.5*	*2.4*	*2.5*	*2.3*	*2.1*	*2.4*	*2.6*	*2.4*	*2.4*
5.0	*4.8*	*4.2* |	*4.2*	*4.0*	*3.9*	*3.8*	*3.7*	*3.9*	*3.9*	*3.9*
4.3	*3.6*	*3.6*	*3.3*	*3.3*	*3.4*	*3.5*	*3.6*	*3.6*	*3.5*	*3.4*
4.3	*4.7*	*4.8*	*4.8*	*4.7*	*4.6*	*4.1*	*4.3*	*6.5*	*(6.0)*	*(6.9)*
3.1	*3.0*	*2.7*	*2.7*	*2.9*	*3.1*	*2.9*	*2.8*	*2.7*	*2.5*	*2.5*
1.2	*1.0*	*0.9*	*0.8*	*0.8*	*0.9*	*0.8*	*0.8*	*1.0*	*1.1*	*1.0*
3.9 |	*3.7*	*3.6*	*3.5*	*3.4*	*3.4*	*3.3*	*3.3*	*3.5*	*3.3*	*3.5*
3.5	*3.6*	*3.6*	*3.5*	*3.4*	*3.3*	*3.1*	*3.1*	*3.2*	*3.1*	*3.1*
7.3 |	*7.4*	*6.8*	*7.0*	*7.4*	*6.9*	*6.0*	*7.4*	*5.3*	*4.1*	*3.5*
4.5	*4.6*	*4.4*	*4.3*	*4.5*	*4.3*	*4.1*	*3.9*	*(6.1)*	*(6.8)*	*(5.9)*
5.7	*5.4*	*5.0*	*4.8*	*5.0*	*5.2*	*4.9*	*5.1*	*5.0*	*5.0*	*4.9*

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
238	272	292	319	352	380	431	484	521	481	504	*648*
1 322	1 344	1 378	1 442	1 457	1 533	1 632	1 682	1 772	1 801	1 885	*2 207*
1 521	1 652	1 805	1 902	1 984	2 097	2 175	2 283	2 430	2 617	(2 636)	*3 311*
338	383	469	482	446	435	475	512	482	522	548	*631*
1 517	1 650	1 660	1 816	1 841	1 972	1 993	2 108	2 253	2 250	2 339	*2 900*
460	495	554	576	598	608	672	739	799	855	904	*972*
58 000	62 000	63 000	64 000	65 000	66 000	67 000	68 000	69 000	70 000	71 000	*70 000*
63 396	**67 796**	**69 158**	**70 537**	**71 678**	**73 025**	**74 378**	**75 808**	**77 257**	**78 526**	**79 816**	*80 669*
5 396	**5 796**	**6 158**	**6 537**	**6 678**	**7 025**	**7 378**	**7 808**	**8 257**	**8 526**	**8 816**	*10 669*

Table 1A.6. WTO: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Bulgaria	*mn leva*	173	163	179	217	258	297	260	230	240
Czechoslovakia	*mn korunas*	8 454	8 359	8 343	9 036	10 302	10 287	9 705	9 618	10 716
German DR	*mn marks*	1 730	..	1 050	1 050	2 835	2 940	3 045	3 255	3 360
Hungary	*mn forints*	..	2 500	3 100	3 376	4 913	6 500	6 163	5 757	5 219
Poland	*mn zlotys*	11 345	14 485	15 110	17 235	18 615	20 960	22 160	23 552	25 551
Romania	*mn lei*	3 597	3 446	3 392	3 639	3 924	4 143	4 346	4 735	4 927
USSR	*mn roubles*	17 000	18 400	18 300	22 800	24 900	27 300	26 100	25 100	26 300

Table 1A.7. WTO: military expenditure as a percentage of gross national product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Bulgaria	*3.7*	*2.9*	*3.0*	*3.4*	*3.7*	*3.9*	*2.3*	*2.6*	*2.5*
Czechoslovakia	*4.5*	*4.3*	*4.0*	*4.2*	*4.6*	*4.7*	*4.5*	*4.4*	*4.3*
German DR	*2.3*	..	*1.2*	*1.1*	*3.1*	*3.1*	*3.1*	*3.2*	*3.1*
Hungary	..	*1.6*	*1.7*	*1.8*	*2.5*	*3.1*	*2.9*	*2.7*	*2.3*
Poland	*3.0*	*3.5*	*3.5*	*3.5*	*3.7*	*3.9*	*3.8*	*3.8*	*3.8*
Romania	*(3.1)*	*(2.6)*	*(2.3)*	*(2.3)*	*(2.3)*	*(2.2)*	*(2.1)*	*2.1*	*2.0*
USSR	*11.0*	*11.2*	*10.4*	*12.3*	*12.5*	*13.4*	*11.9*	*10.7*	*10.5*

Table 1A.8. Other Europe: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Albania[a]	..	..	..	58	65	66	68	70	66	66
Austria	180	178	165	160	168	205	259	214	245	249
Finland	113	134	141	163	229	181	179	182	180	175
Ireland	42	44	47	49	50	51	57	58	56	57
Spain	494	463	548	558	651	670	681	675	797	862
Sweden	1 169	1 218	1 198	1 258	1 352	1 441	1 516	1 608	1 622	1 580
Switzerland	556	536	503	587	648	676	732	738	776	757
Yugoslavia	623	674	642	713	704	709	734	711	680	674
Total Other Europe	**[3 225]**	**[3 300]**	**[3 300]**	**3 546**	**3 867**	**3 999**	**4 226**	**4 256**	**4 422**	**4 420**

[a] At current prices and 1973 exchange rate.

Table 1A.9. Other Europe: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Albania	*mn leks*	..	..	..	[240]	[270]	[275]	282	288	272
Austria	*mn schillings*	1 986	1 989	1 893	1 890	2 076	2 608	3 408	2 957	3 474
Finland	*mn markkaa*	206	246	267	314	460	383	417	446	456
Ireland	*mn pounds*	8.3	8.6	9.2	9.9	10.5	10.8	12.9	14.0	13.7
Spain	*mn pesetas*	11 067	11 115	13 375	13 935	17 173	19 218	20 920	23 471	29 407
Sweden	*mn kronor*	2 706	2 820	2 898	3 107	3 500	3 839	4 173	4 646	4 990
Switzerland	*mn francs*	1 009	972	924	1 096	1 264	1 362	1 521	1 586	1 746
Yugoslavia	*mn new dinars*	1 785	1 956	2 077	2 477	2 701	2 862	3 321	4 305	5 070

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
247	264	302	324	354	391	422	483	548	596	556	588
12 239	13 277	14 072	14 719	15 356	15 487	16 331	17 467	18 133	19 228	19 794	21 114
3 780	5 055	5 490	5 998	6 320	6 528	6 900	7 083	7 512	7 994	8 609	(8 674)
5 433	6 611	7 644	9 448	9 891	9 430	9 489	10 564	11 811	11 671	13 150	14 410
26 850	30 774	33 943	34 534	37 740	38 245	42 119	45 606	49 672	55 432	57 898	63 045
5 146	5 751	6 319	7 067	7 424	7 710	7 835	8 744	9 713	10 500	11 300	12 000
28 500	32 400	34 600	35 200	35 700	36 300	36 900	37 400	38 000	38 500	39 100	39 700

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
2.4	*2.3*	*2.4*	*2.4*	*2.6*	*2.7*	*2.7*	*2.8*	*3.0*	*3.0*	*2.8*
4.3	*4.1*	*3.9*	*3.9*	*3.9*	*3.7*	*3.6*	*3.6*	*3.5*	*3.8*	*3.9*
3.3	*4.2*	*4.3*	*4.5*	*4.4*	*4.4*	*4.4*	*4.3*	*4.3*	*4.4*	*4.5*
2.1	*2.4*	*2.4*	*2.8*	*2.7*	*2.4*	*2.2*	*2.3*	*2.4*	*2.4*	*2.4*
3.8	*4.0*	*4.2*	*4.0*	*3.8*	*3.4*	*3.2*	*3.0*	*2.9*	*3.0*	*2.9*
1.9	*2.0*	*2.0*	*2.1*	*2.0*	*1.9*	*1.7*	*1.7*	*1.7*	*1.7*	..
10.5	*11.0*	*10.9*	*10.0*	*9.7*	*9.6*	*9.0*	*8.7*	*8.6*	*8.3*	*8.0*

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
81	105	115	140	143	142	147	153	189	194	199	*195*
249	257	254	244	260	263	294	327	333	343	385	*563*
201	183	194	211	241	244	249	268	273	234	254	*419*
58	61	69	76	90	95	104	118	107	110	123	*157*
893	927	945	977	1 062	1 161	1 261	1 311	1 374	1 284	1 372	*1 938*
1 583	1 667	1 711	1 739	1 786	1 791	1 806	1 856	1 853	1 847	1 875	*2 645*
721	769	791	823	838	812	809	763	811	819	820	*1 303*
764	771	785	773	868	874	1 079	1 168	1 124	(1 202)	(1 184)	(*2 049*)
4 560	**4 740**	**4 864**	**4 983**	**5 288**	**5 382**	**5 749**	**5 964**	**6 064**	**6 033**	**6 212**	*9 269*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
272	335	435	475	580	590	589	610	635	783	805	824
3 661	3 775	4 006	4 135	4 166	4 712	5 130	6 277	7 567	8 276	8 988	10 470
471	589	549	597	692	847	956	1 148	1 455	1 695	1 632	1 908
14.4	15.5	17.3	21.3	25.5	33.1	38.8	49.9	68.4	73.0	87.0	102.2
33 850	36 780	39 016	42 067	47 019	55 368	67 467	84 749	103 064	127 028	147 764	188 700
5 072	5 176	5 596	6 150	6 714	7 306	7 823	8 666	9 781	10 768	11 959	13 330
1 770	1 726	1 889	2 014	2 232	2 426	2 556	2 795	2 813	3 040	3 110	3 146
5 382	6 406	6 980	7 864	8 948	11 716	14 108	21 100	28 815	30 500	(37 500)	(41 980)

Table 1A.10. Other Europe: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Austria	*1.5*	*1.4*	*1.2*	*1.0*	*1.1*	*1.3*	*1.5*	*1.2*	*1.3*
Finland	*1.6*	*1.7*	*1.7*	*1.8*	*2.4*	*1.9*	*1.8*	*1.7*	*1.6*
Ireland	*1.5*	*1.4*	*1.4*	*1.4*	*1.4*	*1.3*	*1.4*	*1.4*	*1.3*
Spain	*1.9*	*1.8*	*2.2*	*2.0*	*2.1*	*2.0*	*1.9*	*1.8*	*2.0*
Sweden	*4.7*	*4.6*	*4.0*	*4.0*	*4.1*	*4.2*	*4.1*	*4.1*	*4.1*
Switzerland	*3.2*	*2.9*	*2.5*	*2.7*	*2.8*	*2.7*	*2.8*	*2.7*	*2.7*
Yugoslavia[a]	*9.0*	*8.0*	*7.2*	*7.4*	*7.2*	*6.2*	*5.4*	*5.4*	*5.1*

[a] Percentage of gross material product.

Table 1A.11. Middle East: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Bahrain	..	..	..	..	..	..	..	..	..	..
Cyprus	..	..	..	..	..	..	10	12	10	11
Egypt	[293]	[297]	[320]†	[353]	[400]	447	560	607	625	838
Iran	326	364	290	290	287	292	323	434	598	752
Iraq	150	176	201	210	224	261	299	366	374	361
Israel	137	153	182	182	205	254	332	363	461	710
Jordan	(80)	(100)	(93)	(91)	(98)	(98)	(97)	(98)	(116)	121
Kuwait	..	..	..	[32]†	[35]	41	38	58	61	94
Lebanon	25	23	24	29	41	34	37	43	50	55
Oman	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	..	..	..	[143]	[183]	230	224	235	428	624
Syria	[100]	98	98	101	114	119	131	143	117	130
United Arab Emirates[a]	..	..	..	..	..	..	..	..	..	..
Yemen	..	..	..	..	[2]	5	4	5	5	10
Yemen, Democratic[a]	..	..	..	..	..	..	..	..	..	..†
Total Middle East	**[1 225]**	**[1 325]**	**[1 340]**	**[1 450]**	**[1 620]**	**[1 810]**	**[2 090]**	**[2 400]**	**[2 875]**	**[3 735]**

[a] At current prices and 1973 exchange rates.
[b] 1976.

Table 1A.12. Middle East: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Bahrain	*mn dinars*	..	..	..	..	..	..	..	..	..
Cyprus	*mn pounds*	..	..	..	..	..	..	2.7	3.3	2.8
Egypt	*mn pounds*	[73]	[74]	[80]	[89]	[98]	110	143	178	200
Iran	*thous mn rials*	12.8	15.7	13.8	14.2	14.2	14.5	16.6	22.8	31.4
Iraq	*mn dinars*	31.0	35.8	42.4	44.8	48.2	58.3	66.1	80.6	83.9
Israel	*mn pounds*	212	243	294	313	386	511	700	825	1 131
Jordan	*mn dinars*	15.9	20.1	19.1	18.9	20.6	21.0	21.1	21.5	26.0
Kuwait	*mn dinars*	..	..	..	6.1	6.8	7.9	7.1	10.9	12.5
Lebanon	*mn pounds*	45.6	43.0	47.8	56.4	80.6	68.9	76.6	90.1	105.9
Oman	*mn riyals*	..	..	..	..	..	..	..	..	..
Saudi Arabia	*mn rials*	..	..	..	331	428	541	531	561	1 050
Syria	*mn pounds*	[234]	237	251	261	279	297	346	365	316
United Arab Emirates	*mn dirhams*	..	..	..	..	..	..	..	..	..
Yemen	*mn rials*	..	..	..	..	5.3	10.6	10.6	11.7	12.7
Yemen, Democratic	*mn dinars*	..	..	..	..	..	..	..	..	..

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1.3	*1.2*	*1.2*	*1.1*	*1.0*	*1.0*	*1.0*	*1.0*	*1.2*	*1.1*	*1.1*
1.6	*1.7*	*1.4*	*1.4*	*1.5*	*1.5*	*1.4*	*1.4*	*1.5*	*1.5*	*1.4*
1.3	*1.2*	*1.2*	*1.3*	*1.4*	*1.5*	*1.4*	*1.7*	*1.9*	*1.7*	*1.6*
2.1	*2.0*	*1.9*	*1.6*	*1.6*	*1.6*	*1.6*	*1.7*	*1.7*	*1.8*	*1.7*
3.8	*3.7*	*3.6*	*3.6*	*3.7*	*3.7*	*3.6*	*3.5*	*3.4*	*3.3*	*3.4*
2.6	*2.4*	*2.3*	*2.2*	*2.2*	*2.1*	*2.0*	*2.0*	*2.0*	*2.2*	*2.1*
5.2	*5.7*	*5.3*	*5.0*	*4.4*	*4.8*	*4.6*	*5.2*	*5.7*	*5.1*	*(5.4)*

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
..	..	..	(5)†	(5)	5	6	11	(14)	..	[22]	*(21)*[b]
10	9	10	11	10	10	16	(17)	(17)	..	[20]	*(18)*[b]
816	946	1 343	1 756	1 719	3 171	3 502	3 403	2 957	3 107	[1 933]	*4 715*
852	759	959	1 245	2 107	3 691	4 498	5 556	6 712	4 720	4 796	*8 397*
439	536	548	557	538	667	2 037	1 573	(1 261)	1 164	..	*1 664*
1 228	1 715	1 949	1 930	3 735	3 781	3 545	3 052	2 831	2 640	2 346	*3 613*
170	185	143	136	151	146	129	127	124	142	160	*244*
106	202	236	217	221	238	[527]	[722]	[1 535]	[1 257]	..	*[1 870]*
62	60	60	61	87	95	104	105	71	37	68	*71*
..	..	40	51	77	122	310	573	584	317	482	*469*
465	505	570	634	839	1 079	1 324	2 784	3 973	3 584	3 653	*8 997*
201	208	253	214	249	389	382	641	619	630	662	*1 047*
..	..	..	..†	16	24	41	71	544	[641]	..	*[654]*
14	20	25	29	37	35	39	37	[44]	[35]	..	*[80]*
[31]	31	31	32	33	29	(31)	(30)	(32)	(28)	(34)	*(43)*
[4 425]	**[5 225]**	**[6 175]**	**[6 895]**	**9 824**	**13 482**	**16 491**	**18 702**	**21 318**	**[18 338]**	**[17 046]**	*31 903*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
..	..	..	..	(1.8)	(1.8)	1.8	2.8	5.6	(8.3)	..	[16.7]
3.1	2.7	2.6	3.0	3.5	3.4	3.5	6.6	(7.1)	(7.4)	..	[8.6]
270	273	327	482	650	650	1 250	1 530	1 631	1 564	1 845	[1 300]
40.0	45.7	42.2	54.1	73.2	131.9	254.0	353.4	492.3	662.2	592.4	678.3
83.8	104.1	134.3	143.2	150.8	153.3	199.4	659.4	557.9	(493.0)	491.5	..
1 772	3 129	4 481	5 399	5 990	13 080	15 879	20 810	24 950	30 400	38 150	50 850
27.4	38.4	45.2	37.4	37.0	44.1	47.3	50.2	55.2	60.0	78.8	94.2
19.4	22.6	42.1	48.7	53.3	61	71	[178]	[265]	[590]	[530]	..
121.9	135.9	139.1	138.4	142.3	212.9	246.7	300.2	314.9	327.0	211.7	491
..	..	..	12.4	16	25	42	118	241	271	162	271
1 579	1 224	1 396	1 655	1 925	2 657	3 983	5 932	16 790	31 535	31 670	36 150
366	587	600	763	676	793	1 485	1 682	3 280	3 634	4 136	4 550
..	..	..	..	..	64	96	164	285	2 175	[2 565]	..
25	39	57	74	92	121	162	228	265	[370]	[365]	..
..	[8.2]	8.1	8.1	8.9	9.6	10.3	(13.3)	(14.2)	(15.8)	(14.7)	(18.2)

Table 1A.13. Middle East: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Cyprus	..	..	..	..	..	..	2.4	2.4	1.8
Egypt	..	..	5.6	6.0	6.1	6.2	7.0	7.7	8.2
Iran	..	..	4.2	4.2	3.9	3.7	3.9	4.7	5.9
Iraq	6.0	6.7	7.1	6.9	6.9	8.3	7.9	8.8	8.5
Israel	5.9	5.9	6.4	5.7	5.8	6.5	7.8	7.7	9.6
Jordan	..	21.5	19.4	15.7	17.3	16.3	14.2	12.8	15.2
Kuwait	..	..	..	..	..	1.2	1.0	1.5	1.5
Lebanon	..	..	..	..	..	..	2.4	2.6	2.7
Oman	..	..	..	..	..	..	..	..	..
Saudi Arabia	..	..	..	..	..	5.6	5.4	5.1	8.4
Syria	..	..	..	..	..	7.5	7.5	7.9	6.7
Yemen	..	..	..	..	..	..	..	..	..
Yemen, Democratic[a]	..	..	..	..	..	..	..	..	..

[a] Percentage of net domestic product.

Table 1A.14. South Asia: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Afghanistan	..	..	..	..	[43]	[55]	46	44	43	37
Bangladesh	..	..	..	..	..	..	..	..	..	..
India	905	844	848	911	1 256	2 055	2 011	1 961	1 852	1 718
Nepal	..	..	[4]	[4]	[5]	5	4	4	5	6
Pakistan	150	176	184	182	173	188	212	341	398	324
Sri Lanka	16	18	18	18	17	14	14	14	15	16
Total South Asia	**[1 100]**	**[1 075]**	**[1 090]**	**[1 150]**	**1 494**	**2 317**	**2 287**	**2 364**	**2 313**	**2 101**

Table 1A.15. South Asia: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Afghanistan	*mn afghanis*	..	..	[628]	[650]	[650]	[810]	909	1 023	1 088
Bangladesh	*mn taka*	..	..	..	..	..	..	..	..	..
India	*mn rupees*	2 797	2 699	2 774	3 046	4 336	7 306	8 084	8 651	9 027
Nepal	*mn rupees*	..	..	[16.2]	[19.4]	[22.4]	23.7	25.5	28.3	35.2
Pakistan	*mn rupees*	771	878	978	984	938	1 029	1 208	2 059	2 575
Sri Lanka	*mn rupees*	66	72	71	73	68	60	60	62	65

Table 1A.16. South Asia: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Bangladesh	..	..	..	..	..	..	..	..	..
India	[2.0]	[1.9]	[1.9]	1.9	2.6	3.8	3.6	3.6	3.4
Nepal	..	..	..	..	..	..	..	[0.4]	[0.5]
Pakistan	[2.6]	[2.8]	2.8	2.6	2.4	2.4	2.6	4.0	4.5
Sri Lanka	1.1	1.1	1.1	1.1	1.0	0.8	0.8	0.8	0.8

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1.8	*1.5*	*1.2*	*1.3*	*1.3*	*1.1*	*1.0*	*2.2*	*(2.8)*	*(2.3)*	..
10.8	*10.4*	*11.5*	*15.8*	*20.1*	*19.2*	*34.1*	*36.5*	*33.6*	*24.9*	*25.1*
6.8	*6.8*	*5.6*	*6.3*	*7.1*	*10.4*	*14.6*	*12.4*	*14.2*	*15.1*	*11.3*
8.4	*9.2*	*11.4*	*11.2*	*10.3*	*10.4*	*12.3*	*19.5*	*13.9*	..	..
14.7	*21.8*	*26.7*	*27.5*	*24.2*	*40.8*	*38.0*	*34.1*	*29.9*	*27.9*	*26.6*
14.1	*20.5*	*20.6*	*17.8*	*16.6*	*17.7*	*17.6*	*14.7*	*19.8*	*14.9*	*16.5*
2.2	*2.4*	*4.3* ▌	*5.0*	*4.3*	*4.0*	*3.6*	*[5.7]*	*[8.0]*	*[16.6]*	..
3.2	*3.2*	*3.0*	*2.8*	*2.6*	*3.3*	..	..	..	..	..
..	..	..	*11.8*	*12.8*	*17.8*	*24.8*	*20.8*	*32.6*	*32.3*	*18.6*
11.4 ▌	*8.0*	*8.4*	*8.2*	*7.5*	*7.7*	*5.7*	*5.1*	*11.6*	*18.1*	..
5.8	*10.6*	*10.0*	*11.9*	*9.1*	*8.9*	*15.8*	*11.3*	*16.8*	*15.5*	*15.9*
..	..	*2.6*	*3.1*	*3.2*	*3.6*	*4.4*	*4.5*	*5.1*	*[4.9]*	..
..	..	*11.8*	*11.8*	*14.2*	*14.8*	*15.2*	*(17.1)*	..	..	..

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
32	34	30	24	29	39	38	45	60	53	..	*72*
..	..	..	..†	43	40	47	60	103	135	..	*138*
1 788	1 892	1 949	2 320	2 449	2 165	2 014	2 266	2 660	2 584	2 684	*3 180*
6	6	7	7	7	8	8	9	12	13	..	*15*
333	363	396	474	525	470	459	462	463	465	493	*863*
17	17	21	31	28	23	24	25	23	26	(27)	*22*
2 176	**2 312**	**2 403**	**2 856**	**3 081**	**2 745**	**2 590**	**2 867**	**3 321**	**3 276**	**[3 414]**	*4 290*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1 177	1 273	1 322	1 361	1 360	1 467	1 774	1 925	2 479	3 331	3 243	..
..	..	..	..	..	233	311	564	909	1 406	2 026	..
9 535	10 170	10 840	11 747	14 438	16 206	16 737	20 044	23 823	25 793	27 174	28 966
41.9	45.9	51	58	66	73	82	98	125	160	182	..
2 240	2 307	2 588	2 975	3 730	4 350	4 695	5 932	7 212	7 751	8 527	9 655
69	78	85	113	172	162	145	170	192	179	202	(236)

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
..	..	..	..	..	..	*0.6*	*0.6*	*0.8*	*1.3*	..
3.1	*3.1*	*3.0*	*3.0*	*3.4*	*3.5*	*3.0*	*3.0*	*3.4*	*3.4*	..
0.6	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.7*	..	..	..
3.5	*3.4*	*3.5* ▌	*(3.8)*	*[4.5]*▌	*7.2*	*6.2*	*6.1*	*6.0*	*5.7*	*5.8*
0.8	*0.7*	*0.7*	*0.9*	*1.3*	*1.1*	*0.8*	*0.8*	*0.8*	*0.7*	*0.7*

Table 1A.17. Far East: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Brunei[a]	..	..	..	..	..	..	4	12	13	11
Burma	(135)	(153)	(142)	(131)	(141)	(161)	(154)	168	131	129
Hong Kong	..	..	..	..	11	11	10	18	20	24
Indonesia	336	341	401	445	313	216	169	151	104	226
Japan	1 283	1 307	1 298	1 345	1 471	1 565	1 721	1 782	1 905	2 039
Kampuchea, Democratic	..	[66]	[55]	56	58	56	59	55	56	61
Korea, North[a]	..	..	..	275	305	341	366	429	429	576
Korea, South	172	180	178	185	213	177	167	175	214	238
Laos	..	..	..	..	43	27	21	27	27	26
Malaysia	85	75	69	58	59	79	110	155	191	177
Mongolia[a]	..	..	..	18	18	18	18	18	18	24
Philippines	57	63	61	60	61	63	60	60	65	72
Singapore	..	..	..	..	..	..	..	..†	..	42
Taiwan	257	291	270	251	268	324	394	442	523	534
Thailand	92	98	96	101	106	109	116	124	134	154
Viet Nam, North[a, b]	..	..	..	[340]	[390]	[485]	[585]	[620]	[640]	[630
Viet Nam, South[b]	181	179	226	233	326	345	350	602	459	479
Total Far East	**[3 100]**	**[3 300]**	**[3 400]**	**[3 550]**	**3 783**	**3 977**	**4 304**	**4 838**	**4 929**	**5 442**

[a] At current prices and 1973 exchange rates.
[b] From 2 July 1976, North and South Viet Nam constitute a single state, the Socialist Republic of Viet Nam, fo which no military expenditure figures are available.
[c] 1975.

Table 1A.18. Far East: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Brunei	*mn dollars*	..	..	..	..	..	..	8.7	29.3	32.3
Burma	*mn kyats*	406	411	426	408	432	478	466	511	502
Hong Kong	*mn dollars*	..	..	..	..	33	34	34	57	67
Indonesia	*thous mn new rupiahs*	0.011	0.014	0.022	0.032	0.06	0.09	0.15	0.52	3.7
Japan	*thous mn yen*	154	159	163	178	208	238	272	300	337
Kampuchea, Democratic	*mn riels*	..	[1 655]	[1 495]	1 610	1 736	1 764	1 899	1 846	1 851
Korea, North	*mn won*	..	..	..	[565]	[625]	[700]	[750]	[880]	[880]
Korea, South	*thous mn won*	12.8	14.0	14.8	16.7	20.5	20.5	24.9	29.9	40.7
Laos	*mn kips*	..	..	..	..	2 712	3 312	4 935	7 391	8 463
Malaysia	*mn ringgits*	166.2	142.3	131.3	110.9	112.0	154.9	216.5	303.1	379.5
Mongolia	*mn tugriks*	..	..	..	[60]	[60]	[60]	[60]	[60]	[60]
Philippines	*mn pesos*	182	187	193	201	208	219	227	237	270
Singapore	*mn dollars*	..	..	..	..	..	..	..	..	..
Taiwan	*thous mn dollars*	4.8	6.0	6.6	6.6	7.2	8.9	10.8	12.1	14.6
Thailand	*mn baht*	1 390	1 420	1 378	1 473	1 580	1 643	1 778	1 921	2 151
Viet Nam, South[a]	*thous mn piastres*	6.0	6.1	[7.6]	8.3	12.0	13.6	14.3	28.5	35.2

[a] See footnote *b*, table 1A.17.

Figures are in US $ mn, at 1973 prices and 1973 exchange rates. The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
11	8	21	16	15	15	25	45	69	124	122	*123*
125	145	161	162	148	151	108	92	86	103	..	*147*
24	24	25	27	(29)	(22)	(24)	(20)	(30)	(44)	..	*(61)*
292	339	359	405	456	430	401	586	521	624	680	*1 391*
2 177	2 369	2 597	2 875	3 216	3 395	3 447	3 583	3 629	3 723	3 973	*6 226*
62	67	143	143	189	113	[54]	[73]	..	..	..	*[64]*[c]
(824)	877	(878)	922	612	625	765	922	1 007	939	..	*939*
281	324	334	394	443	456	601	747	988	1 249	1 396	*2 031*
24	24	25	26	22	21	17	[18]	[26]	..	..	*[42]*[c]
184	179	243	273	269	280	262	342	335	421	491	*550*
[30]	[38]	[44]	50	(57)	63	110	111	121	120	120	*122*
82	92	104	104	120	207	268	366	327	345	433	*550*
64	128	163	206	218	206	209	263	315	355	..	*460*
579	[575]	577	697	764	819	653	642	708	853	919	*1 464*
185	217	252	298	309	300	285	312	378	449	..	*668*
[630]	[585]	[585]	[585]	[635]	[565]	[585]	[605]	..	..	..	*[605]*[c]
512	540	550	563	661	513	446	[244]	..	..	..	*[465]*[c]
6 086	**6 531**	**7 061**	**7 746**	**8 163**	**8 181**	**8 260**	**8 971**	[9 113]	[9 947]	**[10 850]**	*15 908*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
27.9	27.5	19.4	51.0	38.0	37.3	37.0	60	110	169	303	297
486	498	545	582	599	589	741	675	754	883	1 223	..
84	88	89	100	112	(128)	(112)	(143)	(123)	(191)	(293)	..
21.6	63.1	86.0	102.2	120.5	144.5	178.5	234	407	434	577	683
375	422	483	570	669	783	924	1 166	1 356	1 501	1 664	1 852
2 025	2 154	2 478	5 966	10 206	16 956	26 073	48 320	..	..	..	..
1 180	(1 690)	1 798	(1 800)	1 890	1 254	1 282	1 568	1 890	2 065	1 925	..
50.0	65.4	84.9	101.6	136.1	170.7	181.4	297	463	706	983	1 252
8 531	8 511	8 672	9 131	9 375	10 330	12 732	15 070	..	..	..	..
366.6	379.3	367.3	510	581	591	681	747	1 019	1 026	1 350	1 650
[80]	[100]	[130]	[150]	169	(191)	213	372	375	407	405	404
318	365	421	500	572	728	1 398	2 435	3 542	3 452	4 074	5 491
79	123	244	311	402	434	503	624	806	945	1 101	..
15.4	17.8	[18.5]	19.3	24.0	27.1	31.4	36.9	38.2	43.2	55.7	63.3
2 575	3 152	3 769	4 420	5 319	5 738	6 238	7 296	8 339	10 585	13 628	..
52.8	72.0	92.0	128.3	155.2	228.3	255.8	345	[293]	..	..	..

Table 1A.19. Far East: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Burma	*6.4*	*6.1*	*6.0*	*5.6* ❙	*6.3*	*6.4*	*6.5*	*6.6*	*6.5*
Hong Kong	..	..	..	..	*0.5*	*0.4*	*0.4*	*0.5*	*0.6*
Indonesia	..	..	*5.4*	*6.3*	*4.6*	*2.9*	*2.0*	*2.2*	*1.2*
Japan	*1.3*	*1.2*	*1.1*	*0.9*	*1.0*	*1.0*	*0.9*	*0.9*	*0.9*
Kampuchea, Democratic	..	..	..	..	*7.5*	*6.9*	*7.1*	*6.1*	*5.9*
Korea, South	*6.2*	*6.4*	*6.1*	*5.7*	*5.9*	*4.2*	*3.6*	*3.7*	*4.0*
Malaysia	*3.4*	*2.6*	*2.2*	*1.9*	*1.8*	*1.7*	*2.2*	*2.9*	*3.9*
Philippines	*1.6*	*1.5*	*1.5*	*1.4*	*1.3*	*1.2*	*1.1*	*1.1*	*1.1*
Singapore	..	..	..	..	..	..	..	..	..
Taiwan	*10.7*	*11.6*	*10.5*	*9.4*	*9.4*	*10.2*	*10.6*	*10.6*	*11.5*
Thailand	*2.9*	*2.8*	*2.6*	*2.5*	*2.5*	*2.4*	*2.4*	*2.3*	*2.1*
Viet Nam, South[a]	..	..	*9.2*	*9.7*	*12.7*	*13.4*	*12.3*	*19.9*	*16.0*

[a] See footnote *b*, table 1A.17.

Table 1A.20. Oceania: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Australia	845	887	877	875	912	1 034	1 201	1 387	1 597	1 767
Fiji	..	..	..	..	..	..	..	..	..	..
New Zealand	131	137	141	131	127	132	155	172	182	170
Total Oceania	**976**	**1 024**	**1 018**	**1 006**	**1 039**	**1 166**	**1 356**	**1 559**	**1 779**	**1 937**

Table 1A.21. Oceania: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Australia	*mn dollars*	357	383	392	401	417	475	565	678	804
Fiji	*mn dollars*	..	..	..	..	..	..	..	..	..
New Zealand	*mn dollars*	50	54	56	53	53	56	68	78	85

Table 1A.22. Oceania: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Australia	*3.0*	*2.9* ❙	*2.8*	*2.7*	*2.7*	*2.8*	*3.0*	*3.4*	*3.7*
Fiji	..	..	..	..	..	..	..	..	..
New Zealand	*2.2*	*2.2*	*2.1*	*1.9*	*1.8*	*1.7*	*1.9*	*2.0*	*2.1*

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
5.7	*5.3*	*5.4*	*5.7*	*5.7*	*5.3*	*5.9*	*3.7*	*3.4*	*3.4*	..
0.7	*0.7*	*0.6*	*0.5*	*0.5*	*(0.5)*	*(0.4)*	*(0.4)*	*(0.3)*	*(0.4)*	*(0.5)*
2.5 ‖	*3.0*	*3.2*	*3.1*	*3.3*	*3.2*	*2.6*	*2.2*	*3.2*	*2.8*	*3.0*
0.9	*0.8*	*0.8*	*0.8*	*0.8*	*0.9*	*0.8*	*0.9*	*0.9*	*0.9*	*0.9*
..	..	*5.6*	..	..	..	..	..	..	..	..
4.1	*4.2*	*4.1*	*3.9*	*4.3*	*4.4*	*3.7*	*4.4*	*5.0*	*5.7*	*6.4*
3.7	*3.7*	*3.2*	*4.1*	*4.5*	*4.2*	*3.8*	*3.4*	*4.6*	*3.7*	..
1.2	*1.2*	*1.2*	*1.2*	*1.1*	*1.3*	*2.0*	*2.4* ‖	*3.1*	*2.6*	*2.7*
2.1	*2.9*	*4.9* ‖	*5.4*	*5.9*	*5.3*	*4.9*	*5.0*	*6.0*	*6.5*	*6.8*
10.5	*10.4*	*[9.4]*	*8.5*	*9.2*	*8.8*	*8.1*	*7.0*	*6.8*	*6.6*	*7.5*
2.4	*2.7*	*2.9*	*3.2*	*3.7*	*3.5*	*2.9*	*2.7*	*2.8*	*3.2*	*3.7*
15.8	*20.1*	*17.2*	*16.5*	*16.2*	*20.9*	*16.4*	..	..	..	..

Figures are in US $ mn, at 1973 prices and 1973 exchange rates.
The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
1 920	1 941	1 919	1 932	1 936	1 912	1 982	1 975	1 992	1 981	1 867	*2 609*
(0.5)	0.5	0.7†	0.6	0.7	0.9	0.9	1.0	1.5	1.7	..	*3*
180	187	205	192	194	189	194	198	192	195	(179)	*241*
2 101	**2 129**	**2 125**	**2 125**	**2 131**	**2 102**	**2 177**	**2 174**	**2 186**	**2 178**	**(2 048)**	*2 853*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
918	1 025	1 065	1 094	1 169	1 240	1 340	1 599	1 833	2 100	2 344	2 386
..	0.3	0.3	0.4	0.4	0.5	0.7	0.8	1.1	1.9	2.3	..
84	93	101	118	122	132	139	159	186	210	245	(251)

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3.9	*4.0*	*3.7*	*3.5*	*3.4*	*3.2*	*2.9*	*2.9*	*2.8*	*2.7*	*2.7*
..	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	..
2.0	*2.1*	*2.1*	*2.2*	*1.9*	*1.8*	*1.6*	*1.7*	*1.7*	*1.7*	..

Table 1A.23. Africa: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	196
Algeria	..	..	..	..	(108)†	129	137	155	152	15
Benin[a]	..	..	..†	2.2	(2.9)	(3.4)	(4.1)	4.5	4.0	4.
Burundi	..	..	..	..	(1.6)†	(1.8)	(2.0)	3.0	3.1	3.
Cameroon	..	..	17†	21	27	23	22	24	26	27
Central African Empire	..	..	..†	2.1	2.0	1.9	4.0	3.5	3.6	5.
Chad	..	..	..†	0.1	2.5	2.7	3.0	5.2	8.6	(11.
Congo	..	..	..†	3.7	6.4	(6.5)	7.7	7.3	10.8	12.
Equatorial Guinea	..	..	..	..	..	..	..	..	..	..
Ethiopia	..	(25)	30	(33)	36	48	62	66	60	51
Gabon	..	..	..†	1.7	2.5	3.8	3.0	4.3	4.2	4.
Ghana	20	21	34	47	46	42	38	33	32	51
Guinea[a]	..†	..	..	5	7	7	8	13	16	17
Ivory Coast	..	..	..†	6	14	13	17	20	19	21
Kenya	7.5	6.6	3.7	1.2	0.8	2.7†	8.1	13	17	20
Liberia	..	..	..	..	..	(4.2)	4.1	4.3	4.2	4.
Libya	..	(8)	(7)	(9)	(21)	(23)	25	32	60	(73)
Madagascar	..	..	3†	14	15	14	14	15	16	17
Malawi	..	..	..	..	..	..	(1.1)†	1.2	1.5	1.
Mali	..	..	..†	[8.2]	[8.6]	9.2	9.9	8.6	9.1	9.
Mauritania	..	..	..†	[4.0]	[5.9]	7.0	3.3	3.4	3.2	3.
Mauritius	0.5	0.5	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.
Morocco	70	69	70	80	85	112	100	88	92	99
Mozambique	..	..	..	..	..	..	..	..	..	..
Niger	..	..	..†	2.4	3.9	6.4	7.2	10.1	4.4	5.
Nigeria	25	30	34†	35	41	52	58	68	58	201
Rhodesia, S.	..	..	..	..	..	..	21	25	24	27
Rwanda	..	..	..	..	..†	(2.7)	2.9	3.4	6.6	6.
Senegal	..	..	..†	5	10	13	23	24	22	24
Sierra Leone	..	..	3.0	2.5†	2.7	2.9	3.0	3.0	2.7	2.
Somalia	..	..	..†	5.3	6.0	7.1	7.7	6.5	8.3	9.
South Africa	96	91	103	163	263	267	374	384	416	469
Sudan	26	29	33	33	38	42	54	66	72	72
Tanzania	..	..	..	..†	18	21	27	30	33	37
Togo	..	..	..†	(0.4)	(0.9)	1.4	(4.0)	(4.3)	3.3	3.
Tunisia	14	22	25	28	22	23	27	22	25	23
Uganda	4	4	2	0.3	2†	6	11	19	25	28
Upper Volta	..	..	(2.0)†	(2.4)	6.7	6.8	6.8	4.5	5.0	4.
Zaire	..	..	..†	..	..	39	52	134	121	102
Zambia	10	..	13	20	21	22	11†	29	28	31
Total Africa	**[275]**	**[325]**	**[390]**	**[575]**	**[855]**	**967**	**1 163**	**1 338**	**1 397**	**1 635**

[a] At current prices and 1973 exchange rates.
[b] 1976.
[c] 1975.

Figures are in US $ mn, at 1973 prices and 1973 exchange rates. The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
150	149	139	136	134	138	262	229	263	292	305	*381*
4.5	4.9	5.4	5.8	6.0	6.4	6.5	5.8	7.9	..	..	*7*[b]
3.5	3.4	3.9	4.2	3.8	6.2	6.9	6.3	7.0	..	..	*11*[b]
28	29	30	30	30	33	32	34	35	34	32	*53*
6.4	8.2	7.3	7.5	6.2	7.3	6.9	(6.8)	(6.8)	..	..	*(9)*[b]
(11.5)	15.0	19.7	19.0	(18.5)	19.0	19.3	(17.0)	15.4	..	..	*19*[b]
11.2	12.4	(16.7)	(17.7)	(16.7)	17.7	24.1	19.9	29.6	..	..	*37*[b]
..†	4.3	4.3	4.3	4.6	4.9	5.0	[5.3]	..	..	..	*[5]*[c]
48	47	43	45	50	48	64	74	(71)	(88)	(80)	*(153)*
4.0	5.9	6.5	7.4	7.8	9.3	10.1	11.1	..	..	..	*16*[c]
57	53	47	45	38	41	49	43	30	..	..	*83*[b]
17	17	[22]	[20]	[21]	20	20	(21)	..	..	..	*(21)*[c]
22	22	24	26	27	27	37	33	31	(16)	(38)	*(27)*
20	19	21	26	33	37	41	41	59	130	145	*184*
3.9	4.1	4.7	5.3	4.5	3.7	3.1	3.3	3.8	..	..	*5*[b]
(86)	(124)	(196)	(196)	(153)	(201)	(277)	(170)	(183)	(253)	(275)	*(338)*
18	18	18	19	17	21	20	(22)	(26)	..	..	*(33)*[b]
1.8	1.6	1.8	1.9	2.0	3.0	7.8	7.7	[7.4]	..	..	*[9]*[b]
8.9	10.3	11.8	9.1	11.2	10.0	10.7	[11.4]	17.1	..	..	*20*[b]
3.5	3.6	3.6	3.5	[3.8]	5.7	[7.7]	20.4	(29.3)	(38.1)	..	*(63)*
0.3†	2.1	4.0	4.5	4.8	5.4	5.6	6.5	..	..	..	*9*[c]
116	125	118	126	158	193	172	(174)	[292]	[380]	[515]	*[568]*
..	..	..	..	..	..	..	19†	(54)	(50)	..	*(49)*
5.8	5.5	5.8	6.1	5.0	3.9	3.1	4.8	(6.9)	..	..	*(9)*[b]
346	564	550	468	553	564	671	1 090	1 187	1 156	753	*2 692*
28	28	[62]	[62]	[67]	88	110	122	151	209	266	*280*
5.8	5.1	4.4	5.8	5.2	8.0	6.4	5.9	6.6	..	..	*11*[b]
25	22	25	25	25	20	20	20	25	29	(31)	*46*
3.1	3.7	4.2	4.1	4.1	4.0	4.6	(4.1)	(5.0)	..	..	*(6)*[b]
10.5	10.5	13.1	13.3	15.6	16.1	17.8	(16.9)	16.3	..	..	*26*[b]
467	481	460	511	518	633	848	1 042	1 368	1 717	1 888	*2 140*
88	96	124	143	128	111	90	79	78	92	..	*192*
38	45	55	65	56	56	94	103	100	..	..	*135*[b]
3.9	4.0	4.4	4.6	4.9	5.6	6.3	6.5	9.4	10.1	11.5	*17*
28	27	30	31	35	36	45	56	74	123	128	*164*
35	36	38	65	82	60	46	49	(39)	..	..	*(117)*
4.9	5.1	5.6	5.6	5.9	6.3	(6.2)	(11.7)	(14.8)	..	..	*(16)*[b]
83	96	136	129	116	130	131	(97)	(92)	..	..	*(176)*[b]
34	25	42	93	108	74	82	(75)	(234)	(224)	(206)	*(317)*
1 828	**2 133**	**2 307**	**2 391**	**2 480**	**2 674**	**3 269**	**3 764**	**(4 622)**	**[5 407]**	**[5 461]**	*8 444*

Table 1A.24. Africa: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Algeria	*mn dinars*	..	..	..	..	320	390	425	490	490
Benin	*mn francs*	..	..	..	(480)	(655)	(765)	(905)	995	900
Burundi	*mn francs*	..	..	..	..	86	100	119	182	200
Cameroon	*mn francs*	..	..	2 185	2 840	3 780	3 575	3 585	3 975	4 365
Central African Empire	*mn francs*	..	..	..	250	250	250	580	547	588
Chad	*mn francs*	..	..	..	7	319	367	441	820	1 426
Congo	*mn francs*	..	..	..	500	915	990	1 235	1 235	1 910
Equatorial Guinea	*mn ekueles*	..	..	..	..	..	..	..	..	..
Ethiopia	*mn birr*	..	33	41	46	50	68	90	107	109
Gabon	*mn francs*	..	..	..	245	370	620	500	740	740
Ghana	*mn cedis*	8.5	9.1	14.9	21.9	23.4	21.9	22.2	25.4	25.5
Guinea	*mn syli*	..	..	..	100	150	150	157	275	325
Ivory Coast	*mn francs*	..	..	..	990	2 148	1 976	2 742	3 162	3 260
Kenya	*mn pounds*	1.8	1.6	0.9	0.3	0.2	0.7	2.1	3.5	4.7
Liberia	*mn dollars*	..	..	..	..	..	2.6	2.6	2.8	2.8
Libya	*mn dinars*	..	1.4	1.4	1.8	4.2	4.7	5.4	7.3	14.7
Madagascar	*mn francs*	..	..	396	2 094	2 266	2 211	2 334	2 644	2 800
Malawi	*mn kwachas*	..	..	..	..	..	..	0.7	0.8	1.0
Mali	*mn francs*	..	..	..	[2 020]	[2 130]	[2 330]	[2 400]	2 260	2 365
Mauritania	*mn ouguiyas*	..	..	..	[100]	[150]	197	99	104	100
Mauritius	*mn rupees*	2.0	2.0	1.6	1.3	1.4	1.5	1.5	1.5	1.5
Morocco	*mn dirhams*	198	198	210	244	272	379	354	320	332
Mozambique	*mn escudos*	..	..	..	..	..	..	..	..	..
Niger	*mn francs*	..	..	..	315	488	(855)	(1 010)	1 480	710
Nigeria	*mn nairas*	8	10	12	13	16	20	23	28	26
Rhodesia, S.	*mn dollars*	..	..	..	..	..	..	10.2	12.6	12.6
Rwanda	*mn francs*	..	..	..	..	..	132	(180)	220	480
Senegal	*mn francs*	..	..	..	740	1 480	1 975	3 700	3 900	3 800
Sierra Leone	*mn leones*	..	..	1.5	1.3	1.4	1.5	1.7	1.8	1.7
Somalia	*mn shillings*	..	..	..	23	26	32	39	37	46
South Africa	*mn rands*	40	38	44	71	116	119	171	182	204
Sudan	*mn pounds*	5.0	5.4	6.1	6.8	7.9	9.2	12.2	14.6	16.1
Tanzania	*mn shillings*	..	..	..	..	84	95	124	148	168
Togo	*mn francs*	..	..	..	66	144	229	682	678	584
Tunisia	*mn dinars*	4.4	6.6	7.4	8.6	6.6	7.1	8.6	7.4	8.8
Uganda	*mn shillings*	14	14	8	1	5	20	39	77	102
Upper Volta	*mn francs*	..	..	311	403	1 201	1 294	1 313	860	975
Zaire	*mn zaires*	..	..	..	..	..	3.3	6.1	15.3	15.9
Zambia	*mn kwachas*	3.4	..	4.8	7.2	7.8	8.0	4.2	12.0	12.6

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
490	490	490	488	491	500	545	1 085	1 030	1 288	1 600	1 840
1 000	1 000	1 100	1 200	1 300	1 330	1 415	1 445	1 285	1 759	..	..
212	237	235	273	300	285	492	638	670	900	..	..
4 775	4 990	5 250	5 622	5 920	6 274	7 390	8 334	10 025	11 580	12 770	13 700
827	1 109	1 451	1 351	1 468	1 312	1 616	1 667	(1 935)	(2 140)	..	..
(1 950)	(2 000)	2 700	3 850	3 925	(3 950)	4 300	4 810	(4 930)	4 600	..	..
2 218	2 130	2 336	(3 200)	(3 530)	(3 655)	4 010	5 770	5 570	8 890	..	..
..	..	247	243	246	260	280	282	[300]	..	..	..
93	88	88	88	92	96	102	146	180	(222)	(320)	(356)
740	740	1 130	1 285	1 514	1 682	2 107	2 556	3 612	..	..	..
39.0	47.2	46.8	43.1	42.7	40.0	47.9	73.7	90.6	95.8	..	..
345	350	360	[445]	[415]	[425]	416	413	(440)	..	..	..
3 600	4 000	4 185	4 900	5 335	5 425	6 025	9 860	9 834	10 458	(6 600)	(18 300)
5.7	5.8	5.6	6.1	7.9	10.6	13.1	16.6	19.8	30.6	74.9	93.6
3.3	2.8	3.3	3.8	4.3	3.8	3.7	3.7	4.5	5.4	..	..
(20)	(24)	(36)	(61)	(61)	(47)	(63)	(90)	(60)	(68)	(100)	(130)
2 990	3 220	3 380	3 370	3 840	3 625	4 660	5 290	(6 470)	(7 895)	..	..
1.1	1.1	1.0	1.2	1.4	1.5	2.4	7.2	8.2	[8.2]	..	..
2 540	2 565	2 950	3 400	3 175	4 200	4 455	5 290	[6 000]	9 700	..	..
108	117	125	135	142	[165]	265	[400]	1 200	(1 975)	(2 830)	..
1.5	1.5	9.4	18.1	20.4	23.2	29.4	39.5	52.6	..	..	..
356	419	464	444	493	642	817	856	(935)	[1 700]	[2 500]	[3 700]
..	..	..	..	..	..	..	..	600	(1 760)	1 900	(3 650)
855	915	960	1 025	1 120	1 010	890	725	1 225	(2 175)	..	..
87	151	271	299	289	351	371	516	1 104	1 463	1 726	1 458
14.1	15.3	15.4	[34]	[35]	[39]	53	71	86	119	184	255
391	357	329	315	433	396	670	703	838	1 020	..	..
4 050	4 300	3 960	4 461	4 678	4 969	4 461	5 225	6 907	8 823	10 998	(11 140)
1.7	2.1	2.6	3.1	3.0	3.2	3.3	4.3	(4.6)	(6.5)	..	..
54	60	64	80	81	92	101	132	(149)	165	..	..
238	241	256	257	303	327	438	655	913	1 332	1 861	2 260
17.9	19.6	24.1	32.5	38.0	38.0	38.6	39.7	43.0	48.4	66.7	..
194	207	244	312	385	357	391	785	1 081	1 127	..	..
629	670	735	830	948	1 063	1 261	1 604	1 960	3 153	4 118	4 700
8.4	10.5	10.5	11.8	12.6	14.6	15.8	20.5	28	39	69	77
120	142	163	190	376	462	418	535	690	(840)	(952)	..
910	930	1 045	1 160	1 205	1 230	1 400	(1 500)	(3 350)	(3 885)	..	..
18.3	23	30	48	48	50	65	84	(79)	(142)	..	..
14.6	17.9	13.3	23	54	66	48	58	(58)	(215)	(246)	(265)

Table 1A.25. Africa: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Algeria	..	..	..	..	[2.7]	(3.1)	3.2	3.5	3.2
Benin	..	..	..	1.3	1.7	1.9 ▌	2.1	2.2	1.9
Burundi	..	..	..	..	..	(1.4)	..	1.4	..
Cameroon	..	..	..	..	[2.7]	2.4	2.2	2.3	2.3
Central African Empire	..	..	..	0.7	0.7	0.7	1.5	(1.3)	(1.3)
Chad	..	..	..	..	0.6	0.7	..	1.4	..
Congo	..	..	..	[1.5]	[2.6]	(2.7)	[3.2]	[2.9]	[4.2]
Ethiopia	..	..	1.7	1.9	1.9	2.4	2.9	3.2	3.1
Gabon	..	..	..	0.7	0.9	1.4	1.0	1.5	1.3
Ghana	1.1	1.0	1.6	2.1	2.1	1.8	1.6	1.6 ▌	1.7
Guinea	..	..	..	[2.0]	[2.7]	(2.7)	..	..	..
Ivory Coast	..	..	..	0.6	1.3	1.0	1.1	1.3	1.3
Kenya	0.8	0.7	0.4	0.1	0.1	0.3 ▌	0.6	1.0	1.1
Liberia	..	..	..	..	..	(0.9)	0.9	1.0	0.9
Libya	..	..	..	..	2.4	1.9	1.4	1.4	2.2
Madagascar	..	..	0.3	[1.5]	1.5	(1.5)	1.5	1.6	1.5
Malawi	..	..	..	..	..	..	0.5	0.4	0.5
Mali	..	..	..	..	..	..	2.8	..	..
Mauritania	..	..	..	[2.3]	[3.1]	3.6 ▌	1.4	(1.4)	[1.2]
Mauritius	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Morocco	2.4	2.4	2.3	2.7	2.6	3.2	2.8	2.4	2.6
Niger	..	..	..	0.6	0.8	1.3	1.5	2.0 ▌	0.7
Nigeria	0.4	0.5	0.5	0.5	0.6	0.7	0.7	0.8	0.7 ▌
Rhodesia, S.	..	..	..	..	..	..	1.5	1.7	1.7
Rwanda	..	..	..	..	..	..	..	..	..
Senegal	..	..	..	0.5	0.9	1.1	2.0	2.0	1.8
Sierra Leone	..	..	..	..	..	..	0.7	0.7	0.6
South Africa	0.8	0.8 ▌	0.8	1.3	2.0	1.8	2.4	2.3	2.4
Sudan	1.5	1.5	1.6	1.7	1.8	2.0	2.6	3.0 ▌	3.2
Tanzania	..	..	..	..	1.6	1.9 ▌	2.1	2.4	2.4
Togo	..	..	..	[0.2]	[0.5]	0.7	1.8	1.6	1.1
Tunisia	..	..	2.2	2.3	1.7	1.6	1.8	1.4	1.6
Uganda	0.5	0.5	0.3	0.03	0.2	0.4	0.8	1.3	1.7
Upper Volta	..	..	(0.7)	[0.8]	[2.3]	(2.4)	[2.4]	1.5	1.7
Zaire	..	..	..	..	..	1.7	3.1	5.6	5.2
Zambia	1.2	..	1.1 ▌	1.8	1.9	1.9	0.9 ▌	1.8	1.6

[a] GDP figure used excludes the three Eastern states.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3.0	2.6	2.4	2.1	2.1	1.8	1.8	2.1	2.1	1.9	2.0
2.1	2.0	2.1	2.1	2.1	2.0	2.0	1.9	1.3	1.4	..
..	1.5	1.4	1.5	1.6	1.4	2.2	2.4	2.1	2.4	..
2.3	2.1	2.0	1.9	1.9	1.8	1.9	1.7	1.6	1.6	..
1.8	2.2	2.7	2.4	2.6	2.1	2.6	2.3	(2.3)	(2.3)	..
(3.3)	(3.4)	3.9 ▮	5.1	4.9	(5.3)	5.6	4.2	(3.3)	3.0	..
[4.6]	4.0	4.0	(5.0)	(5.1)	(4.3)	4.0	4.5	4.5	6.2	..
2.5	2.2	2.1	1.9	1.9	2.0	1.9	2.6	3.1	..	..
1.3	1.0	1.3	1.4 ▮	1.4 ▮	1.6	1.3	0.7	0.8	..	..
2.6	2.8	2.3	1.9	1.7	1.4	1.4	1.6	1.5	..	..
..	4.9	4.6	..	..	..	..	..	..	..	..
1.3	1.2	1.2 ▮	1.2	1.2	1.1	1.1	1.3	1.2	0.9	(0.4)
1.3	1.2	1.1	1.1	1.2 ▮	1.5	1.6	1.6	1.7	2.1	4.1
1.0	0.8	0.9	0.9	1.0	0.8	0.7	0.5	0.5	0.6	..
(2.6)	(2.2)	(2.8)	(4.6) ▮	(3.7)	(2.6)	(2.8)	(2.3)	(1.6)	(1.4)	(1.7)
1.6	1.5	1.5	1.4	1.4	1.3	1.6	1.4	(1.6)	(1.9)	..
0.5	0.5	0.4	0.4	0.4	0.4	0.6	1.5	1.4	[1.2]	..
..	..	2.2	..	1.9	2.4	2.5	2.6	..	..	..
[1.2]	1.2	1.3 ▮	1.4	..	[1.3]	2.0	..	..	..	..
0.2	0.2	0.9	1.7	1.8	1.6	1.6	1.2	1.5	..	..
2.6	2.7	2.9	2.6	2.7	3.2	3.8	3.2	(3.1)	[4.8]	[6.1]
0.9	1.0	1.0	0.9	..	..	..	..	..	..	..
2.8[a]	5.2[a]	7.5[a]	5.7	4.2	4.6	4.3	3.9	7.3	..	..
1.7	1.8	1.5	[3.2]	[2.8]	[2.8]	3.4	3.9	4.3	5.5	8.3
2.6	2.1	1.7	1.4	2.0	1.7	2.7	2.4	2.7	..	..
2.0	2.0	1.8	1.9	1.9	1.7	1.9	1.9	2.0	2.5	..
0.6	0.7	0.8	0.9	0.9	0.9	0.8	0.8	(0.8)	(1.0)	..
2.5 ▮	2.4	2.2	2.0	2.2	2.1	2.3	2.8	3.5	4.5	5.5
3.3	3.4 ▮	3.8	4.4	4.8	4.4	3.6	2.9	2.4	..	..
2.6	2.6	3.0	3.4 ▮	3.9	3.2	3.0	4.9	5.7	4.9	..
1.1	1.1	1.1	1.1	1.2	1.2	1.4	1.3	1.6	..	..
1.4	1.7	1.5	1.6	1.4	1.3	1.3	1.3	1.6	2.0	3.2
1.9 ▮	1.9	1.9	2.0	3.6	4.1	3.2	3.3	3.6	(3.4)	..
.. ▮	1.1	..	1.3	..	1.3	..	(1.3)	..	..	..
5.9 ▮	3.2	3.3 ▮	5.0	4.6	4.4	4.4	4.5	(4.1)	(4.9)	..
1.6 ▮	1.7	1.0 ▮	1.8	4.6	4.9	3.0	3.1	(3.6)	(11.2)	(12.8)

Table 1A.26. Central America: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Costa Rica	7.7	7.7	7.8	7.5	7.7	7.6	7.2	7.9	8.8	9.0
Cuba[a]	..	..	..	207	237	252	262	252	252	296
Dominican Republic	51	63	51	50	48	46	49	47	44	42
El Salvador	8.7	7.2	7.1	7.4	10.3	10.8	10.6	10.8	11.1	11.1
Guatemala	12	12	12	11	11	12	16	18	18	20
Haiti	12	12	12	13	13	12	12	11	10	10
Honduras	6.5	6.5	5.9	10.1	10.1	10.4	7.8	7.5	8.7	9.4
Jamaica	..	..	..	..	1.4†	5.9	6.1	6.3	6.4	6.7
Mexico	120	120	132	141	158	173	194	195	238	236
Nicaragua	..	..	..	11	12	12	11	11	13	14
Panama	..	..	..	..	3.5	3.5	3.4	4.0	3.4	5.0
Trinidad and Tobago	..	..	..	..	..†	2.7	4.0	3.4	3.3	3.4
Total Central America	**[375]**	**[400]**	**[435]**	**458**	**512**	**548**	**583**	**574**	**617**	**663**

[a] At current prices and 1973 exchange rate.
[b] 1976.
[c] 1975.

Table 1A.27. Central America: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Costa Rica	*mn colones*	(31.8)	32.0	32.9	32.6	34.3	35.0	34.2	37.2	41.6
Cuba	*mn pesos*	..	..	..	175	200	213	221	213	213
Dominican Republic	*mn pesos*	34.5	42.6	33.4	31.6	33.1	34.0	37.0	35.0	32.4
El Salvador	*mn colones*	19.0	15.6	15.3	15.5	21.7	23.0	23.0	23.6	23.9
Guatemala	*mn quetzales*	9.8	9.8	9.4	9.2	9.3	10.2	12.7	14.3	14.7
Haiti	*mn gourdes*	35.0	34.4	33.3	35.5	37.7	36.2	38.8	36.6	35.4
Honduras	*mn lempiras*	[9.1]	9.3	8.2	14.4	14.5	15.4	12.0	12.0	14.1
Jamaica	*mn dollars*	..	..	..	..	0.7	3.0	3.2	3.4	3.5
Mexico	*mn pesos*	862	883	1 021	1 111	1 258	1 388	1 589	1 651	2 100
Nicaragua	*mn córdobas*	..	..	..	49.2	53.2	54.3	53.2	57.2	65.9
Panama	*mn balboas*	..	..	..	..	[2.7]	[2.7]	[2.7]	[3.2]	(2.7)
Trinidad and Tobago	*mn dollars*	..	..	..	..	..	3.3	4.9	4.3	4.3

Table 1A.28. Central America: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Costa Rica	1.3	1.2 ❘	1.2	1.1	1.1	1.0	0.9	0.9	1.0
Cuba[a]	..	..	..	..	6.6	6.2	5.3	5.1	5.3
Dominican Republic	4.8	6.1	4.6	4.5	3.7	3.4	3.4	3.7	3.1
El Salvador	1.4	1.2	1.1	1.1	1.4	1.4	1.2	1.2	1.1
Guatemala	0.9	0.9	0.9	0.9	0.8	0.8	1.0	1.1	1.1
Haiti	..	..	2.4	2.6	2.6	2.4	2.3	2.1	1.9
Honduras	[1.3]	1.2 ❘	1.2	2.0	1.9	1.9	1.3	1.2	1.3
Jamaica	..	..	..	..	0.1 ❘	0.5	0.5	0.5	0.5
Mexico	0.7	0.6 ❘	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Nicaragua	..	..	..	1.9	1.9	1.8	1.5	1.4	1.6
Panama	..	..	..	..	0.5	0.5	0.4	0.5	0.4
Trinidad and Tobago	..	..	..	..	..	0.3	0.4	0.3	0.3

[a] Percentage of gross material product.

Figures are in US $ mn, at 1973 prices and 1973 exchange rates. The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
11.7	12.7	5.6	7.3	7.3	8.1	8.2	10.2	13.2	14.5	16.6	*18*
355	296	343	343	316	320	334	(386)	..	..	..	*(393)*[c]
43	42	40	40	40	37	42	45	(47)	(37)	(40)	*(57)*
13.1	32.0	10.8	12.9	13.3	20.6	22.3	20	25.4	..	..	*38*[b]
19	18	33	21	22	21	22	30	32	37	[33]	*61*
10	10	10	9	10	8	7	8	8	8	..	*12*
8.1	16.8	9.7	12.5	16.2	15.9	14.8	(18.0)	(21.1)	(18.5)	(21.8)	*(25)*
6.9	6.0	6.6	7.8	8.1	12.9	11.8	(13.0)	(14.7)	..	..	*(24)*[b]
254	267	273	294	332	353	342	408	442	461	407	*574*
13	13	15	15	19	15	20	23	31	..	..	*37*[b]
4.9	7.3	9.1	15.6	9.9	10.7	11.0	11.9	(12.0)	..	..	*(15)*[b]
3.2	3.3	5.0	5.0	4.7	3.7	4.0	5.0	(5.8)	..	..	*(8)*[b]
742	**724**	**761**	**783**	**799**	**826**	**839**	**978**	**[1 052]**	**[1 065]**	**[1 017]**	*1 262*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
42.8	58.0	64.5	30.1	39.9	42.0	53.3	70.6	102.5	137.7	157.4	189.2
250	300	250	290	290	267	270	282	(326)	..	..	..
31.2	32.5	31.0	31.3	31.9	34.4	36.6	47.6	57.2	(64.9)	(57.1)	(65.6)
24.3	29.5	71.8	24.9	29.9	31.3	51.4	65.1	69.7	94.8	..	..
16.3	15.7	15.6	28.7	18.5	19.5	20.7	26.0	39.7	47.3	61.2	[58.5]
35.8	35.6	35.2	35.8	36.6	39.1	39.9	42.3	50.9	55.8	60.9	..
15.4	13.6	28.9	17.2	22.8	31.1	31.7	33.3	(42.9)	(53.0)	(50.5)	(62.8)
3.8	4.1	3.8	4.6	5.7	6.3	11.7	13.6	(17.7)	(22.0)	..	..
2 148	2 355	2 560	2 750	3 125	3 700	4 409	5 292	7 262	9 100	12 260	12 660
72.4	70.9	72.2	85.8	86.8	112.9	107.4	154.4	190.9	262.4	..	..
4.1	4.1	6.2	7.9	13.9	9.3	10.7	13.0	14.7	(15.3)	..	..
4.5	4.6	4.9	7.5	7.8	8.0	7.3	9.5	13.9	(17.9)	..	..

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
0.9	*1.1*	*1.1*	*0.5*	*0.6*	*0.5*	*0.5*	*0.5*	*0.6*	*0.7*	*0.6*
6.1	*6.9*	*6.0*	*6.9*	*6.0*	*4.4*	*4.0*	*3.8*	..	..	..
2.8	*2.8*	*2.3*	*2.1*	*1.9*	*1.7*	*1.6*	*1.6*	*1.6*	*(1.7)*	*(1.3)*
1.1	*1.3*	*3.0*	*1.0*	*1.1*	*1.1*	*1.5*	*1.7*	*1.5*	*1.7*	..
1.1	*1.0*	*0.9*	*1.5*	*0.9*	*0.9*	*0.8*	*0.8*	*1.1*	*1.1*	*1.1*
1.9	*1.9*	*1.8*	*1.7*	*1.6*	*1.6*	*1.2*	*1.1*	*1.1*	..	..
1.3	*1.0*	*2.2*	*1.2*	*1.5*	*1.9*	*1.7*	*1.7*	*(1.9)*	*(2.1)*	*(1.6)*
0.5	*0.5*	*0.4*	*0.4*	*0.4*	*0.4*	*0.7*	*0.6*	*(0.7)*	*(0.8)*	..
0.7	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*	*0.7*
1.6	*1.5*	*1.4*	*1.6*	*1.5*	*1.8*	*1.4*	*1.5*	*1.7*	*2.0*	..
0.5	*0.5*	*0.7*	*0.8*	*1.2*	*0.7*	*0.7*	*0.7*	*0.8*	*(0.8)*	..
0.3	*0.3*	*0.3*	*0.4*	*0.4*	*0.4*	*0.3*	*0.2*	*0.3*	*(0.3)*	..

Table 1A.29. South America: constant price figures

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Argentina	682	540	596	580	558	559	515	573	646	704
Bolivia	[4]	[5]	[6]	7	7	15	15	17	16	15
Brazil	770	620	574	519	554	544	583	863	736	1 013
Chile	178	143	154	157	158	144	135	153	189	199
Colombia	63	52	59	70	111	122	115	126	127	130
Ecuador	23	20	27	26	25	22	25	28	26	28
Guyana	. .	. .	. .	. .	. .	. .	. .	. .	1.2†	2.8
Paraguay	. .	. .	. .	9	9	10	10	11	12	13
Peru	125	111	108	128	127	175	171	170	169	215
Uruguay	. .	. .	. .	29	30	42	41	46	44	52
Venezuela	184	178	161	155	148	177	183	206	213	242
Total South America	**[2 060]**	**[1 700]**	**[1 725]**	**1 680**	**1 727**	**1 810**	**1 793**	**2 193**	**2 179**	**2 614**

[a] 1976.

Table 1A.30. South America: current price figures

	Currency	1958	1959	1960	1961	1962	1963	1964	1965	1966
Argentina	*thous mn new pesos*	0.098	0.171	0.236	0.263	0.325	0.402	0.452	0.647	0.962
Bolivia	*mn pesos*	[26]	[35]	[49]	58	61	137	147	178	175
Brazil	*mn cruzeiros*	41	44	55	70	114	194	388	924	1 157
Chile	*mn pesos*	0.082	0.091	0.109	0.119	0.135	0.179	0.245	0.358	0.542
Colombia	*mn pesos*	306	272	317	410	664	965	1 072	1 218	1 467
Ecuador	*mn sucres*	282	247	336	336	329	307	370	428	413
Guyana	*mn dollars*	. .	. .	. .	. .	. .	. .	. .	. .	2.0
Paraguay	*mn guaranies*	. .	. .	. .	[750]	[750]	[860]	[840]	[975]	1 132
Peru	*mn soles*	1 265	1 259	1 340	[1 687]	[1 785]	2 614	2 824	3 286	3 575
Uruguay	*mn new pesos*	. .	. .	. .	0.187	0.221	0.365	0.509	0.9	1.5
Venezuela	*mn bolivares*	601	607	540	533	509	613	650	742	782

Table 1A.31. South America: military expenditure as a percentage of gross domestic product

	1958	1959	1960	1961	1962	1963	1964	1965	1966
Argentina	*2.5*	*2.3*	*2.3*	*2.2*	*2.2*	*2.1*	*1.7*	*1.8*	*2.1*
Bolivia	[*0.8*]	[*0.9*]	[*1.1*]	*1.2*	*1.1*	*2.4*	*2.3*	*2.5*	*2.2*
Brazil	*2.8*	*2.2*	*2.0*	*1.7*	*1.7*	*1.6*	*1.7*	*2.5*	*2.2*
Chile	*2.7*	*2.2*	*2.6*	*2.5*	*2.4*	*2.1*	*1.9*	*1.9*	*2.1*
Colombia	*1.5*	*1.2*	*1.2*	*1.3*	*1.9*	*2.2*	*2.0*	*2.0*	*2.0*
Ecuador	*2.3*	*1.9*	*2.4*	*2.2*	*2.0*	*1.8*	*1.9*	*1.9*	*1.7*
Guyana	. .	. .	. .	. .	. .	. .	. .	. .	*0.5*
Paraguay	. .	. .	. .	[*1.8*]	[*1.7*]	[*1.8*]	[*1.6*]	[*1.7*]	*1.9*
Peru	*3.1*	*2.7*	*2.4*	[*2.6*]	[*2.4*]	*3.2*	*2.9*	*2.9*	*2.6*
Uruguay	. .	. .	. .	*1.1*	*1.2*	*1.6*	*1.6*	*1.7*	*1.5*
Venezuela	*2.4*	*2.4*	*2.1*	*2.0*	*1.7*	*1.9*	*1.8*	*2.0*	*2.0*

Figures are in US $ mn, at 1973 prices and 1973 exchange rates. The final column X is at current prices and exchange rates.

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1977X
595	633	659	585	611	627	700	888	1 008	877	827	*1 000*
13	11	14	13	18	21	24	33	36	38	42	*75*
1 017	1 119	1 056	1 444	1 514	1 767	1 072	1 076	1 216	1 422	1 306	*1 889*
212	236	323	330	398	575	991	768	787	883	1 284	*497*
171	99	121	223	116	104	100	108	113	90	98	*137*
31	40	41	36	42	50	58	71	66	64	..	*114*
2.3	2.5	3.7	3.3	3.8	4.0	6.4	(8.0)	(7.2)	..	..	*(8)*[a]
13	14	16	11	19	17	16	19	17	20	21	*31*
215	226	285	297	276	337	345	(469)	[378]	292	..	*345*
39	53	59	77	69	65	56	78	48	45	..	*64*
241	228	229	277	312	304	422	475	324	401	451	*558*
2 549	**2 662**	**2 807**	**3 296**	**3 379**	**3 872**	**3 789**	**3 993**	**4 000**	**(4 141)**	**[4 472]**	*4 718*

Figures are in local currency, current prices.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1.354	1.329	1.521	1.800	2.155	3.566	5.869	8.131	29.19	180.1	415.5	1 057
179	168	144	197	187	272	418	787	1 157	1 325	1 500	1 820
2 066	2 574	3 492	3 926	6 498	8 033	10 831	8 202	10 722	16 406	26 950	34 400
0.681	0.917	1.319	2.405	2.951	6.314	41.43	431.7	1 587	5 076	10 930	22 600
1 627	2 263	1 437	1 885	3 789	2 255	2 479	2 950	4 023	4 975	5 120	6 580
456	527	714	767	742	933	1 263	1 790	2 522	2 592	2 850	..
4.8	4.0	4.5	6.7	6.1	7.5	8.5	15.6	(21.1)	(20.7)	..	..
1 226	1 292	1 414	1 514	1 075	2 131	2 165	2 513	3 173	3 048	3 876	4 421
4 994	5 957	6 650	8 800	9 800	9 765	13 040	15 600	(26 250)	[28 200]	30 040	..
3.3	5.6	9.3	11.9	19.4	30.6	56.9	86.3	219	205	304	..
885	894	867	891	1 112	1 290	1 309	1 969	2 440	1 792	2 392	2 870

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
2.3	*1.9*	*1.9*	*1.9*	*1.6*	*1.6*	*1.6*	*1.6*	*2.2*	..	..
2.0	*1.6*	*1.3*	*1.6*	*1.4*	*1.6*	*1.6*	*1.8*	*2.3*	*2.2*	..
2.9	*2.6*	*2.6* |	*1.9*	*2.4*	*2.2*	*2.2*	*1.1*	*1.1*	*1.1*	*1.2*
2.0	*2.0*	*2.0*	*2.5*	*2.3*	*2.6*	*3.4*	*4.5*	*3.8*	*3.5*	*3.4*
2.0	*2.3*	*1.3*	*1.4*	*2.5*	*1.2*	*1.0*	*0.9*	*1.0*	*0.9*	..
1.7	*1.8*	*2.2* |	*2.3*	*1.8*	*2.0*	*2.0*	*1.9*	*2.3*	*2.0*	*1.9*
1.1	*0.9*	*0.9*	*1.3*	*1.1*	*1.3*	*1.3*	*1.6*	*(1.8)*	*(1.9)*	..
2.0	*2.0*	*2.0*	*2.0*	*1.3*	*2.2*	*1.7*	*1.5* |	*1.7*	*1.4*	*1.5*
3.2	*3.2*	*3.2*	*3.7*	*3.7*	*3.3*	*3.6*	*3.5*	*(4.7)*	*[3.7]*	*2.9*
1.9	*1.5*	*1.8*	*1.9*	*2.6*	*2.5*	*2.2*	*1.9*	*2.6*	*1.6*	..
2.1 |	*2.0*	*1.9*	*1.7*	*1.9*	*2.0*	*1.7*	*1.5*	*2.0*	*1.4*	*1.6*

Appendix 1B

Sources and methods for the world military expenditure data

Square-bracketed numbers, thus [1], *refer to the list of references on page 64.*

This appendix describes the sources and methods used in the preparation of the tables on military expenditure (appendix 1A). Only the main points are noted here. The tables are updated and revised versions of those which appeared in the SIPRI Yearbook 1978.

I. Purpose of the data

The main reasons for collecting and presenting data on world military expenditure are, first, to show trends, over a period, in military expenditure, in individual countries and regions and in the world as a whole; and second, to provide an indication of the resources absorbed by military activities and, to some extent, of the overall volume of these activities. For reasons mentioned below, expenditure figures are often unsuitable for comparing the military efforts of any two countries at a particular point in time.

The purpose of publishing the ratio between military expenditure and national product is to give an indication of the defence burden on the economies of individual countries and to provide a rough yardstick of comparison between the burden in different countries.

II. Definitions and restrictions

For the purpose of showing the resources absorbed by military activities in each country, military expenditures are defined to include weapon research and development, to include military aid in the budget of the donor country and to exclude it from the budget of the recipient country, and to exclude war pensions and payment on war debts.

However, a rather large proportion, especially of the developing nations, do not specify how their military outlays are spent, and thus the figures for these countries may not agree with this definition.

In general the military expenditure estimates may be interpreted as indications of the volume of military activities in the countries concerned. For many small countries receiving large amounts of military aid, however, they considerably understate this activity. This is naturally also the case for countries with a foreign military presence. Data on military aid in the form of major weapons are given in the arms trade registers (appendices 3A and 3B).

For the United States in particular and to a lesser extent for other major arms-producing countries, there may also be some misrepresentation of the volume of activity, since payment for arms procurement may lag behind the actual production work.

Conclusions about the military capability of one country in comparison with another can rarely be drawn from these tables because of differences in coverage, the difficulty of finding appropriate exchange rates, and the fact that price conditions vary widely between countries. These price variations are mainly rooted in differences in the degree of industrialization, but depend also on differences in economic system.

For calculating the ratio of military expenditure to national product, gross domestic product (GDP) at purchasers' values has been used. It is defined as "the final expenditure on goods and services, in purchasers' values, *less* the c.i.f. [cost, insurance, freight] value of imports of goods and services" [1]. For the Warsaw Treaty Organization countries, military expenditure in proportion to net material product (NMP) has been given in previous editions of the *Yearbook*, as NMP is the official measure for national product in these countries. Since this measure, however, excludes a variety of services which are included in GDP, this practice has been abandoned. In the present edition military expenditure is instead expressed as a percentage of estimates of gross national product (GNP) at market prices, which for these countries cannot be more than negligibly different from the ratio to GDP.

Countries and time period covered

Appendix 1A covers all the countries in the world.[1]

The tables are presented by region in the following order: NATO (North Atlantic Treaty Organization), WTO (Warsaw Treaty Organization), Other Europe, Middle East, South Asia, Far East, Oceania, Africa, Central America and South America. The individual countries are listed alphabetically within each of these regions.

Data are provided for a 21-year span, with data for 1978 added and the earliest year shown in the *SIPRI Yearbook 1978* dropped. Estimates going back to 1948 can be found in previous editions of the *Yearbook*.

The military expenditure estimates refer to calendar years in all cases. For countries where the government fiscal year differs from the

[1] Exceptions are a number of states with populations less than one million, and a few others, for example Angola, for which data are unavailable.

calendar year, conversion to a calendar-year basis is made on the assumption of an even rate of expenditure throughout the fiscal year. This may reduce fluctuations of the series, but does not affect the total amounts spent over the years.

III. Methods

The estimates of military expenditure for NATO countries are taken from official NATO data; they differ from the figures published in the military budgets of the individual countries since they are adjusted to correspond to a common definition. The estimates for WTO countries other than the USSR are taken from reference [2a] for the period 1965 to 1976; these include for Czechoslovakia, the German Democratic Republic and Poland some estimates for research and development expenditure which may not be included in the official budgets, and exclude an estimated 'civilian' portion of internal security for the countries that publish defence and internal security expenditures taken together only. For the years after 1976, the official budget percentage changes are used to update the Alton figures. The same procedure is used for the years before 1965. For the Soviet Union a 'compromise' figure has been taken which corresponds neither with the official figures nor with the CIA estimates; the reasons are explained in chapter 1 (page 28). For the remaining countries in the world, the prime source is the series given in the United Nations' *Statistical Yearbook* (UNSY), where it is available. As a general rule no adjustments are made to these figures (which have been notified to the United Nations by governments), except to bring them up to date. The latest figures in the series have mainly been taken from journals and newspaper articles giving the most recent budget estimates. The few countries that are not included in the UNSY have presented difficulties, as most of these do not publish their defence budgets regularly. The estimates of their military spending have necessarily been derived from other sources and therefore must be taken to be highly approximate, and subject to revision when more information becomes available.

The estimates are intended to show the amount of money actually spent (outlays) for military purposes. It should be noted that in some countries there are alternative series for funds budgeted, appropriated (set aside) or obligated (committed to be spent). Since our objective is to show the defence burden on the national economy, series for actual expenditures, where available, have been chosen in preference to these alternatives.

Being a budget estimate, the estimate for the latest year in each series cannot be attributed the same reliability as previous figures. For many countries this is true for other years as well. This degree of uncertainty relating to the figures derives from the fact that contingencies may result in actual expenditures which differ—occasionally very widely—from the budgeted amounts; and government accounting procedures can require a considerable time after the closing of the fiscal year to arrive at a final figure for the total amount paid out during that period. Also, as the sources for the most recent years generally are not the same as those used for the earlier years in the series, the problem of interpreting and comparing different sources arises. Different sources often give widely different data, and the question of which source to use is a matter of judgement. When switching from one source to another, the percentage change from the up-to-date source has, when possible, been applied to the SIPRI series.

The data on GDP are taken primarily from the UNSY and the UN *Yearbook of National Accounts Statistics*. These figures are updated in the UN *Monthly Bulletin of Statistics*. Data from the International Monetary Fund's *International Financial Statistics* have been used, where they have been more up to date than the other sources. The GNP estimates for the USSR were obtained by converting the GNP dollar-estimate for 1975 given in reference [3a] to roubles and constructing a series by applying the percentage changes in the net material product series. For the other WTO countries, figures for the ratio of military expenditure to GNP at market prices calculated in domestic currencies were cited directly from reference [2b] for the years 1965–76 and the other years calculated using the NMP series.

IV. Calculations

In order to provide time series estimates of total world military expenditure at constant prices, for the purpose of enabling volume comparisons, two operations must be performed. First, all national expenditures must be converted into a common currency. The most widely used for such a purpose is the US dollar, which practice SIPRI has also adopted. Second, it is necessary to adjust for the effect of price changes. The figures in this *Yearbook* are presented at 1973 price levels and 1973 exchange rates.

For most countries the official exchange rate in 1973 is used or, if this fluctuated during the year, the weighted average rate. For the WTO countries other than the USSR, the exchange rates given in reference [2b] were used. For the Soviet Union, we have used the 'purchasing-power-parity' estimate derived from national product comparisons of the United States and the Soviet Union, of 1.79 dollars to the rouble in 1973 [3b].

The adjustment for changes in prices was made by applying the consumer price index in each country. In many countries this is the only price index available. As an index of the general movement of prices, it is a reasonable one for showing the trend in the resources absorbed by the military, in constant prices. For the most recent year, the estimate of the consumer price increase is based on the figures for the first 7–10 months only. For the USSR, no adjustment for prices is made since the figure for military expenditure is so rough and inflation practically zero. For the other WTO countries adjustments were made according to the official consumer price index.

The calculations on the ratio of military expenditure to GDP/GNP were all made in domestic currencies and for calendar years.

V. Sources

The sources of the data presented in appendix 1A are of five general types: official national documents; journals and periodicals; newspapers; books, monographs and annual reference works; and documents issued by international and intergovernmental organizations. The common criterion for all these sources is that they are open sources, available to the general public.

The official national documents include budgets; parliamentary or congressional reports and hearings; White Papers, annual reports and other documents issued by governments and agencies; and statements by government officials and spokesmen.

The following list contains a selection of the periodical publications which are regularly used for relevant data on military expenditure and national product.

Journals and periodicals

Africa Research Bulletin (Exeter, UK)
Afrique Défense (Paris)
Air et Cosmos (Paris)
Air Force Magazine (Washington)
Air International (Bromley, UK)
Arab Report and Record (London)
Armed Forces Journal (Washington)
Armies and Weapons (Genoa)
Asian Recorder (New Delhi)
Atlantic News (Brussels)
Congressional Quarterly Weekly Report (Washington)
Defense and Foreign Affairs Digest (Washington)
Defense Business (Washington)
Défense et Diplomatie (Paris)
Economist (London)

Facts and Reports (Amsterdam)
Far Eastern Economic Review (Hong Kong)
Flight International (London)
IDSA News Review on China, Mongolia and the Koreas (New Delhi, Institute for Defence Studies & Analyses)
IDSA News Review on Japan, South East Asia and Australasia (New Delhi, Institute for Defence Studies & Analyses)
IDSA News Review on South Asia (New Delhi, Institute for Defence Studies & Analyses)
IDSA News Review on West Asia (New Delhi, Institute for Defence Studies & Analyses)
IMF Survey (Washington, International Monetary Fund)
Interavia (Geneva)
International Defense Review (Geneva)
International Financial Statistics (Washington, International Monetary Fund)
Keesing's Contemporary Archives (Bristol)
Latin America (London)
Latin America Economic Report (London)
Milavnews (Stapleford, UK, Aviation Advisory Services)
Monthly Bulletin of Statistics (New York, United Nations)
Monthly Bulletin of Statistics, The Republic of China (Taipei)
National Defense (Washington)
Nato Review (Brussels)
New Times (Moscow)
Quarterly National Accounts Bulletin (Paris, OECD)

Newspapers

Asahi Evening News (Tokyo)
Dagens Nyheter (Stockholm)
Daily Telegraph (London)
Financial Times (London)
Hsinhua News (Stockholm)
International Herald Tribune (Paris)
Krasnaja Zvezda (Moscow)
Le Monde (Paris)
Neue Zürcher Zeitung (Zurich)
Pravda (Moscow)
Rand Daily Mail (Johannesburg)
Sunday Times (London)
Svenska Dagbladet (Stockholm)
Times (London)
Trybuna Ludu (Warsaw)

Annual reference publications

Africa (Africa Journal Ltd., London)
Africa Contemporary Record (Rex Collings, London)
Africa Guide (Africa Guide Company, Saffron Walden, UK)
Africa South of the Sahara (Europa Publications, London)
Aid Economic Data Book: Africa, . . . Far East, . . . Latin America, . . . Near East and South Asia (Washington, United States Agency for International Development)
Asia Yearbook (Far Eastern Economic Review Ltd., Hong Kong)

Europa Year Book—A World Survey (Europa Publications, London)
"Defence Expenditures of NATO Countries", NATO press release (Brussels, NATO)
Far East and Australasia (Europa Publications, London)
Far Eastern Economic Review Yearbook (Far Eastern Economic Review Ltd., Hong Kong)
Middle East and North Africa (Europa Publications, London)
Military Balance (London, International Institute for Strategic Studies)
Sivard, R. L., *World Military and Social Expenditures* (WMSE Publications, Leesburg, Virginia)
Statesman's Year-Book (Macmillan, London)
Statistical Yearbook (New York, United Nations)
World Military Expenditures and Arms Transfers (Washington, United States Arms Control and Disarmament Agency)[2]
Yearbook of National Accounts Statistics (New York, United Nations)

VI. Conventions

. .	Information not available or not applicable
( )	Uncertain data or SIPRI estimates of military expenditure based on budget figures
[ ]	Rough estimate of military expenditure
†	Year of independence
▮	GDP figures used after this year are not *strictly* comparable with those for preceding years.

References

1. *Statistical Yearbook* (United Nations, New York, 1974), p. XVII.
2. Alton, T. P., Lazarcik, G., Bass, E. M. and Znayenko, W., 'Defense expenditures in Eastern Europe, 1965–76', in *East European Economies Post-Helsinki*, A compendium of papers submitted to the Joint Economic Committee, US Congress (US Government Printing Office, Washington, D.C., 1975).
   (a) —, pp. 267–88.
   (b) —, p. 270.
3. Ruth L. Sivard, *World Military and Social Expenditures* (WMSE Publications, Leesburg, Virginia, March 1978).
   (a) —, p. 21.
   (b) —, p. 30.

[2] This source was previously called *World Military Expenditures and Arms Trade*, and before that, *World Military Expenditures*.

2. World arms production

Square-bracketed numbers, thus [1], *refer to the list of references on page 70.*

I. The volume of arms production

The arms production registers in this *Yearbook* (appendices 2A and 2B) list more than 1 000 individual weapons in production or under development. Of this production, 40 per cent consists of aircraft designs, 30 per cent of ship designs, 20 per cent of missiles, and the rest of armoured vehicles.

The leading producer countries are easily defined by examining the data in these registers. A breakdown of producers by major weapon categories is shown in table 2.1.

A similar breakdown of leading producers in the Third World is made in table 2.2.

Table 2.1. Eight largest industrialized producers of major weapons, by weapon category

Figures are numbers of weapon types produced.

Producing country	Aircraft	Armoured vehicles	Missiles	Warships	**Total**
USA	91	16	41	33	**181**
USSR	40	8	34	30	**112**
France	36	9	28	23	**96**
UK	24	14	19	26	**83**
Italy	24	6	14	15	**59**
FR Germany	8	14	4	15	**41**
China	7	3	10	10	**30**
Sweden	10	1	6	6	**23**

Source: SIPRI computer-stored data base.

II. The type of arms

Aircraft

Most of the aircraft currently in production include various types of fighter aircraft, ranging from the most sophisticated designs, such as the Boeing E-3A Sentry with highly advanced electronic equipment, to the comparatively primitive armed trainers equipped for counterinsurgency. Of the 90 fighter aircraft currently in production, 24 types are designed or used for counterinsurgency.

Table 2.2. Ten largest Third World producers of major weapons, by weapon category

Figures are numbers of weapon types produced.

Producing country	Aircraft	Armoured vehicles	Missiles	Warships	**Total**
Brazil	19	4	3	1	**27**
Israel	9	4	4	5	**22**
Argentina	7	2	2	9	**20**
India	15[a]	1[a]	3	5	**19**
North Korea	1[a]	–	–	(10)[a]	**11**
Taiwan	5	–	4	1	**10**
South Africa	3[a]	1	1[a]	–	**5**
Pakistan	4[a]		1[a]	–	**5**
Peru	1[a]			4	**5**
Indonesia	4[a]			1[a]	**5**

[a] Most of these types are produced under licence.

Source: SIPRI computer-stored data base.

Table 2.3. Major weapon types in production, 1978

Aircraft	Armoured vehicles	Missiles	Warships
Helicopter, 125	MBT, 39	AAM, 29	FPB, 96
Fighter, 123	APC, 39	ASM, 23	Frigate, 32
Transport, 102	AC, 22	ATM, 22	Submarine, 22
Trainer, 82	LT, 15	ShShM, 20	Destroyer, 15
Reconnaissance, 17		SAM, 19	Corvette, 13
ASW/maritime patrol, 17			
AEW, 4			

Note: See appendix 3C for the abbreviations used in the table.

Source: SIPRI computer-stored data base.

The number of helicopter types in production (99) also includes many used for counterinsurgency purposes. There are further many various transport and trainer types (82 and 58, respectively). The more modern aircraft, to be deployed in the early 1980s, are described as close support fighters, strike fighters or multipurpose fighters.

Four airborne early warning systems are in production: the Boeing E-3A Sentry and E-4B Prowler, the Grumman E 2C Hawkeye, and the British Nimrod-3.

The general trend away from heavy, specialized fighter planes towards lightweight multirole fighters is clearly visible. Among the performance criteria today, experience from the wars in Indo-China and elsewhere can be traced—short take-off and landing capacity, multi-mission payloads and high-altitude capacity.

Third World production of aircraft is concentrated on counterinsurgency types, trainers and transports. For example, the Italian Aermacchi MB-326 is produced under licence in Brazil as the AT-26 Xavante. Brazil also produces its own counterinsurgency design, the Uirapuru-122, and Argentina produces the locally designed IA-58 Pucará.

More sophisticated fighter aircraft are produced by Israel—the Kfir-C2, which was originally derived from the Mirage-3 and -5—and a strike fighter called Arye is planned. India, after more than 20 years of experience with a local design known as Marut, is planning a deep-penetration strike fighter for the 1980s called the HF-25.

Armoured vehicles

The 'lessons' learned from the wars in the Middle East and Indo-China are reflected also in the types of armoured vehicles in production: the trend points away from concentration on the heavy battle tank forces towards lighter, multi-purpose, cross-country vehicles. The light tanks and armoured cars of the 1970s are equipped with anti-armour missiles.

Few Third World countries produce armoured vehicles, whether on licence or from indigenous designs: India has long experience of production of the Vijayanta tank, which is a derivative of the Vickers 37-ton tank, but in future it will instead import the Soviet T-72, presumably for financial reasons.

Israel has developed a design of its own, the Merkava, and Brazil is exporting locally designed armoured cars.

Missiles

A rough breakdown of missile types (see table 2.3) illustrates the fact that the major weapon platforms, that is—aircraft, ships and tanks—are by now equipped with missile systems, and also that ground forces are normally being equipped with missile batteries for air defence.

The missile systems produced in the Third World are mostly air-to-air missiles or anti-tank missiles, under licence. The sole surface-to-surface system reported was the Jericho SAM in Israel, but there is no recent information on the status of the programme.

Warships

In shipbuilding, the emphasis today lies on fast patrol boats with missile systems but also on technologically highly advanced frigates and destroyers, equipped for both air defence and antisubmarine warfare.

Hydrofoil missile-equipped fast patrol boats are a relatively new development and are being produced by China, Italy, the UK, the USA and the USSR.

The Third World countries mostly produce patrol boats and support ships. No Third World country has tried to develop a heavier ship of local design. Argentina, Brazil and India, however, produce British frigates and destroyers under licence.

In chapter 6 a detailed analysis of warships is given.

III. The producers

The general position of the United States as a dominant technological power is also reflected in its arms-producing capacity. There are today more than 1 100 major US corporations, employing over 700 000 workers, which are engaged almost exclusively in the research, development and production of weapons. If related industries are added, the figure is multiplied. Experts have estimated the total volume of arms production in the United States to be worth $46 000 million [1].

In the UK 200 000 people are directly employed on Ministry of Defence contracts, with a further 80 000 working on arms export contracts. The defence industry output constitutes about 2.5 per cent of the British GDP and 3.5 per cent of exports.

Obviously, some branches of industry are more involved than others —50 per cent of the aerospace sales and one-third of all shipbuilding are for military goods and services [2].

There is a general pattern in all the industrialized Western countries towards a concentration of arms production in bigger companies, and also towards a reduction of the types of weapons produced. For the smaller nations, financial reasons lie behind the trend towards a decrease in local designs, replaced by import from the major powers. Sweden provides a good example of this development: the long debate about the future development of the B3LA fighter resulted in cancellation of the programme. The producer side claims that this will mean the end of the existence of a technologically advanced Swedish aircraft industry.

The escalating costs of RDT&E (research, development, testing and evaluation) for weapon systems are a direct result of the increasingly complex technology needed to meet the performance requirements. The most expensive components of this technology are electronics and data processing devices.

Even for such major producers as the United States, the size of the production runs needed to reduce the costs by now exceeds the needs of the local armed services. The effect of inflation must, of course, be added.

Given the financial difficulties observed in the industrialized countries, it is possible to conclude that the burden for an under-developed country, with inadequate manpower and infrastructure, will be even greater. It is rather hard to see any 'development effect' of investments in the military industry sector. Rather it can be claimed that the leading arms-producing nations—in the industrialized world as well as in the Third World—in effect are sustaining a war economy at the expense of the development of civilian sectors of the economy. (This subject will be pursued further in a forthcoming SIPRI publication, *The Global Arms Trade*.)

IV. Licence production

In the industrialized world, licence production is chosen rather than direct import of weapons, for financial reasons. The proportion of licence contracts to imports for industrialized countries (74:285) is much higher than for the Third World (78:748). Licence production in Third World countries is often started for political reasons, to counter the effects of an embargo (India, Pakistan, Israel, South Africa, Brazil and Argentina).

Those countries which produce weapons under licence are listed in table 2.4. A breakdown of countries which sell technology, that is, issue licences, is shown in table 2.5.

Table 2.4. World-wide licensed production of major weapons, 1978, by licensee country

Country	Number of projects
Italy	19
Japan	14
India	13
Argentina	10
Brazil	7
Taiwan	7
Belgium	6
South Africa	5
Pakistan	5
Iran	5

Source: SIPRI computer-stored data base.

V. Co-production

There are currently 28 international projects in production or under development in Europe. NATO plans for standardization and

Table 2.5. World-wide licensed production of major weapons, 1978, by licence-issuing country

Country	Number of projects
USA	68
UK	22
France	22
FR Germany	20
USSR	8
Italy	6
Switzerland	2
China	2
Czechoslovakia	2
Sweden	1

Source: SIPRI computer-stored data base.

co-production in order to reduce the number of compatible weapon systems in use with the national forces, have turned out to be very difficult to realize. The different national demands have prevailed and there are many examples of cancelled co-production projects. France and FR Germany stand out as one of the few exceptions with the many Euromisile projects, but on the other hand the only type of arms co-produced is missiles (see appendix 2A, register I, under *International*).

References

1. Gervasi, T., *Arsenal of Democracy* (Grove Press, New York, 1977).
2. Freedman, L., *Arms Production in the United Kingdom* (Royal Institute of International Affairs, London, 1978).

Appendix 2A

Registers of indigenous and licensed production of major weapons in industrialized countries, 1978

I. Register of indigenously designed major weapons in development or production in industrialized countries, 1978

For sources and methods, see appendix 3C. For conventions, see page 252.

Note:
The key to the *region code* is given in the conventions, page 255.
The *countries* are listed in alphabetical order. Under the heading *International*, projects involving joint design by two or more countries are entered; projects designed by one country and produced by two or more countries are entered under the designing country.
The *weapons* produced by each manufacturer are listed in the following order: aircraft, armoured vehicles, missiles and warships.
The key to abbreviations in the *weapon description* column is given in appendix 3C, page 253.
The *standard equipment* columns show the origin of vital components and standard armaments, such as power plant, radar and electronics, anti-aircraft cannons and so on. The abbreviations used are given in appendix 3C, page 253.
For *technical data*: *speed* for aircraft, armoured vehicles and missiles is given in km per hour, and for warships in knots. *Weight* for aircraft is empty weight in kg; for armoured vehicles, combat weight in kg; for missiles, warhead weight in kg; and for warships, displacement empty, in tonnes (for submarines, displacement surface, in tonnes).
The *years* columns: for warships they are years laid down, launched and year when first ship of the particular class was completed/commissioned, respectively.

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
7 Austria	Steyr-Daimler	Cuirassier	LT				..	..	..
	Steyr-Daimler	Pinzgauer	APC				..	..	..
11 Australia	GAF	N-22B Nomad	Transport	P: TP	USA		2 019	311	1 352
	GAF	N-22L Nomad	Coast patrol	P: TP	USA		2 019	311	1 352
	GAF	N-24A Nomad	Transport	P: TP	USA		2 170	311	1 463
	Dept. of Production	Ikara-1	ShShM	P: S			..	..	20
	Dept. of Production	Ikara-2	ShShM	P: S			..	..	20
	Dept. of Production	Ikara-3	ShShM	P: S			..	..	20
	Williamstown	Cook	Survey	P: D Ship Son	 1		1 900	17	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost ($ mn)	Unit cost ($ mn)	Comments
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1965	1971	1974	10	..	46	..	0.5	Two military versions in production: Missionmaster and Searchmaster; 11 in use with Australian Army
..	1978	..	..	..	..	..	1.1	For coastal patrol use; u.c. 12% more expensive than N-22B; first flight Feb 1978
..	1976	..	..	..	..	..	0.6	Australian government approved funding for 120 aircraft, including civilian version
..	..	1961	..	..	..	..	..	Version for indigenous use; 1 launcher/ship with fast automatic reloading; missile delivers homing torpedo
..	..	..	..	..	..	..	..	Version for UK Navy; joint Australian/UK modification programme
1970	..	..	..	..	..	..	..	Version for Brazilian Navy; differs from Ikara 1 and 2 in computer equipment
1974	1977	1979	..	1	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Carrington	LSH type	LSH	P: D Cann Ship Hel	 UK	 2 2	5 800	17	..
	..	Type 420	FPB				..	36	4 320
4 Belgium	Boel/Cockerill	Westhinder	Frigate	P: GT RL ShAM ShSh Son TT	UK Swe USA Fra USA	 6 8 4 2	1 860	28	4 500
4 Canada	Canadair	CL-215	Amphibian	P: P	USA		12 065	291	2 260
	DeHavilland Canada	DHC-5D Buffalo	Transport	P: TP	USA		..	420	3 280
	DeHavilland Canada	DHC-6	Transport	P: TP			..	338	1 775
	DeHavilland Canada	DHC-7R Ranger	Transport	P: TP			11 282	432	2 650
	Breton	Cape Harrison	FPB	P: D			120	20	..
3 China	..	..	Hel				..	..	..
	..	..	Transport	P: TF	Can		..	..	..
	Shenyang	F-12	Fighter	P: TF	UK/ China		..	2 937	..
	Shenyang	F-6	Fighter	P: TJ	China		5 760	1 452	2 200
	Shenyang	F-9	Fighter	P: TJ	USSR		..	1 909	800
	Shenyang	Il-28	Bomber	P:	China		..	..	..
	State arsenal	K-63	APC				11	..	..
	State arsenal	T-60	Amph LT	P: D	China		15	40	240
	State arsenal	T-62	LT				21	..	..
	State arsenal	AT-3	ATM	P: S			..	..	..
	State arsenal	CSA-1	SAM	P: S			130	4 284	50
	State arsenal	CSA-X	ShAM				..	..	3

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	1979	1980	..	1	..	..	..	Capacity: 550 troops or 1 tank squadron
..	..	..	..	..	..	..	..	
1974	1975	1977	2	..	4	..	..	Arms: 8 × Seasparrow, 1 sextuple Bofors RL; China expressed interest in purchasing
..	1967	..	..	..	..	..	..	
..	1974	1975	18	..	78	..	..	Exported to 14 air forces
1964	1965	1966	..	..	600	..	..	
1972	1978	..	..	50	..	..	..	Funds allocated for 50
..	..	1977	1	3	..	..	..	For Coast Guard
..	..	1977	..	..	..	..	..	New development of previously licence-produced Mi-4
1977	..	..	..	..	..	..	..	Believed to be under development with Canadian P
1977	1980	..	..	..	..	..	..	Design reportedly based partly on MiG-23 (acquired from Egypt) but with UK Spey P
..	1961	1961	(120)	..	(1 500)	..	..	Chinese version of Soviet MiG-19; production believed to continue at slow rate
..	1972	..	..	..	..	..	..	Believed to be development of F-6 (MiG-19) but performance disappointing; production in small number; current status unknown
..	..	..	..	..	(300)	..	..	In service in bomber role; Chinese development of Soviet Il-28; production believed to continue at slow rate
..	..	1972	..	..	..	..	..	
..	..	1972	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	1968	..	..	..	..	..	Copy of Soviet AT-3 still in production; delivered to Kampuchea 1978
..	..	..	..	..	..	..	..	Copy of Soviet SA-2; production reportedly declining
..	..	..	..	..	..	..	..	Reportedly copy of Soviet SA-3; shipborne version for Kiangtung-class ships; no land-based version reported

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	State arsenal	CSS-2	IRBM	P: SL			..	..	4 000
	State arsenal	(CSS-3	ICBM	P: LP			..	..	6 500
	State arsenal	CSS-N-1	ShShM	P: S			400	..	42
	State arsenal	(CSS-X-4	ICBM	P: LP			3	..	..
	State arsenal	FROG-type	SSM	P: S			..	..	40
	State arsenal	..	ShShM				..	..	..
	State arsenal	..	(SLBM)	P: S			..	..	..
	..	Hai Dua class	FPB				..	..	..
	..	Hainan class	FPB	P: D Cann	 China	 7	360	28	..
	..	Hoku class	FPB	P: D Cann ShSh	China China China	 2 2	70	40	..
	Hutang Shanghai	Hu Chwan class	Hydrofoil TB	P: D Cann TT	 China China	 4 2	45	50	500
	Hutang Shanghai	Kiang Hu type	Frigate	Cann ShSh	China China	12 4	1 800	..	..
	Hutung Shanghai	Kiang Tung type	Destroyer	P: D Cann ShAM	China China China	 12 4	1 600	28	..
	Luta	Luta type	Destroyer	P: T Cann RL ShSh	 China China China	 6 2 6	3 250	32	4 000
	..	Osa-2	FPB	P: D Cann ShSh	 China China	 4 4	165	32	800
	Canton/ Shanghai	Romeo class	Sub	P: DE			1 400	14	0
	..	Shanghai-2	GB	P: D Cann TT	 China China	 8	120	30	..
5 Czecho- slovakia	Aero	L-39 Albatross	Trainer	P: TF	USSR		3 330	979	910
	Aero	L-39Z Albatross	Fighter/ground attack	P: TF Cann Rock Rock	USSR USSR Czech USSR	 1 8	3 500	832	..
	..	Zlin-43	Trainer	P: P	Czech		730	273	1 150
	Czech State Arsenal	OT-64	APC	P: D MG	Czech Czech		14	94	710

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1971	..	..	(20)	..	..	
..	1976)	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	1976)	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	1977	..	..	6	..	..	New type; reportedly on Hai Dua-class ships
..	..	..	..	..	..	..	..	
..	..	1978	..	..	1	..	..	Reportedly new class; 1 ship in service with 6 new ShShM; more under construction
1963	..	1965	(4)	..	(23)	..	..	Estimated production rate: 4/year
..	..	1970	(10)	..	(76)	..	..	Local development of ex-Soviet Komar-class; estimated production rate: 10/year
1956	..	..	(10)	..	(120)	..	..	Licence-produced in Romania
1974	1975	1976	(2)	..	(5)	..	..	
1971	1973	1977	1	..	2	..	..	First Chinese ship with ShAM
..	..	1971	..	..	(7)	..	..	
..	..	1970	10	..	(80)	..	..	Local development of ex-Soviet Osa-2; only ship of reported Hola-class (Osa-2) version now in service
..	..	..	6	..	(51)	..	..	Local development of ex-Soviet Romeo-class
..	1959	1965	10	..	(340)	..	..	Production of Shanghai-1 completed
..	1968	1972	..	..	..	..	..	Selected as standard trainer for WTO forces in 1972; entered service in Czechoslovakia in 1974; now being delivered to WTO
..	..	1977	..	..	..	..	..	COIN version under development
..	..	1972	16	..	(112)	..	..	
1959	..	1964	..	..	..	..	..	

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
4 Denmark	Svendborg	Lindormen class	Minelayer	P: D			570	14	..
				Cann		2			
	Aalborg Yard	Niels Juel class	Frigate	P: D	UK/ FRG		1 320	28	..
				Cann	Italy	1			
				ShAM	USA	8			
				ShSh	USA	8			
	Frederikshavn	Willemoes class	Corvette	P: GT	UK		260	40	..
				Cann	Italy	1			
				ShSh	USA	8			
7 Finland	Valmet	LEKO-70	Trainer	P: P	USA		740	360	1 015
	Holming Oy	..	CPB	P: D			..	12	..
	Rauma Repola	Improved Dubna	Tanker	P: D			12 000	16	..
	Waertsila	..	Minelayer	P: D	Fin		1 100	..	..
				Cann	Swe	1			
				Cann		6			
	Laivatollisuus	..	PB	P: D			550	16	..
	..	Schoolship	Training	Cann	Swe	1	880	..	..
				Cann		2			
				Hel					
	Uusikaupunki	Sorum type	Ocean tug	P: D			1 630	..	..
4 France	Aérospatiale	AS-350B	Hel	P: TS	Fra		1 027	272	740
	..	Atlantic-4	ASW/mar patrol				..	..	..
	Dassault	Falcon-20G	Mar patrol	P: TF	USA		7 960	979	3 890
	Aérospatiale	Fouga-90	Trainer	P: TF	Fra		2 606	639	1 852
	Dassault	Mirage F-1A	Fighter/ground attack	P: TJ	Fra		7 400	2 692	..
	Dassault	Mirage F-1B	Trainer				7 400	2 692	..
	Dassault	Mirage F-1C	Fighter/interc	P: TJ			7 400	2 692	..
	Dassault	Mirage-2000	Fighter/interc	P: TJ	Fra		..	2 937	..
				Cann		2			
				AAM		4			

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1977	..	1978	2	2	..	..	..	
1977	..	1979	..	3	..	..	..	Design purchased from Glasgow Yard; arms: Seasparrow and Harpoon
1974	1975	1978	3	..	10	..	..	Design purchased from Lürssen; produced in 1976–78
1973	1975	1977	..	30	..	..	..	To replace Saab Safir; to be delivered in 1979–81
..	..	1978	2	..	2	..	..	
1978	..	..	..	4	..	..	..	
1976	..	1979	..	1	..	..	..	Design stage completed; arms: 1 × 20-mm Bofors cannon
1976	..	..	..	3	..	..	..	
1978	..	..	..	1	..	..	..	Arms: 1 × 120-mm Bofors cannon, 2 × 40-mm cannon
..	..	1973	..	9	..	..	..	First 3 seen 1973; 1 launched in Dec 1976 and 1 in May 1977
1973	1974	1977	30	..	40	..	..	Replacement for Alouette-3; version B marketed in all countries except North America; version C marketed in North America
.	1977	1980	..	..	..	..	..	Developed to meet navy requirement; first delivery for 1985; cooperation from Aeritalia, Dornier, Fairey and Fokker planned; design: Breguet Atlantic
.	1975	1979	..	..	..	..	..	Design won US Coast Guard contract for delivery from mid-1979
977	1978	..	..	..	..	..	..	Development of Magister; large export market foreseen
964	1966	1972	..	..	105	..	..	Greater fuel capacity than F-1C; licence-produced in South Africa
.	..	1976	..	..	..	..	..	
964	1966	1972	114	..	219	194.4	..	Production line to operate until 1981 due to new export orders; F-1E version built for European fighter contest now abandoned; co-production with Belgium
975	1978	1981	..	..	..	..	17.0	First production aircraft to be delivered 1981; to be built in attack, recce and strike versions

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Dassault	Mirage-3000	Fighter-bomber	P: TJ	Fra		..	..	..
	Dassault	Mirage-3D	Trainer	P: TJ	Fra		..	..	..
	Dassault	Mirage-3E	Fighter-bomber	P: TJ	Fra		7 050	2 692	..
	Dassault	Mirage-3R	Recce	P: TJ AAM	 Fra	 2	7 050	2 692	..
	Dassault	Mirage-3RD	Recce				..	..	..
	Dassault	Mirage-4000	Fighter	P: TF Cann AAM	Fra Fra Fra		..	..	..
	Dassault	Mirage-5	Fighter	P: TJ	Fra		6 600	2 692	4 000
	Dassault	Mirage-50	Fighter	P: TJ	Fra		9 500	2 448	..
	Dassault	Mirage-5SD	Fighter	P: TJ	Fra		6 600	2 692	..
	Aérospatiale	Nord-262A-2	Transport	P: PI	Fra		6 200	370	1 110
	Aérospatiale	Nord-262A-2M	Mar patrol	P: PI	Fra		6 200	370	1 100
	Aérospatiale	SA-315B Lama	Hel	P: TS	Fra		1 018	120	..
	Aérospatiale	SA-316B	Hel	P: TS	Fra		1 122	185	540
	Aérospatiale	SA-319B	Hel	P: TS	Fra		1 108	197	605
	Aérospatiale	SA-331	Hel	P: TS	Fra		..	..	..
	Aérospatiale	SA-332	Hel	P: TS	Fra		7 616	289	..
	Aérospatiale	SA-360 Dauphin	Hel	P: TS ATM Cann	Fra Fra/ FRG	 8	1 564	315	680
	Aérospatiale	SA-361 Dauphin	Hel	P: TS	Fra		..	315	680
	Aérospatiale	SA-365 Dauphin	Hel	P: TS	Fra		1 823	315	555
	Aérospatiale	SA-365N Dauphin	Hel				..	..	..
	Dassault	Super Etendard	Fighter/ASW	P: TJ Cann ASM	Fra Fra Fra		6 273	1 203	3 334
	Aérospatiale	Super Frelon	Hel	P: TS	Fra		6 702	275	1 020
	Aérospatiale	TB-30	Trainer				..	353	1 200

'ear design egun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
978	..	..	..	..	..	..	..	
.	1961	..	..	..	174	..	..	2-seat version exported to 12 air forces and licence-produced in Australia
.	1961	1964	48	..	..	..	..	Production line to operate until 1980 due to new orders
.	1961	..	..	..	153	..	..	
.	1961	..	..	..	20	..	..	Designation: R version with improved navigation system
977	1979	..	..	..	..	..	..	Development initiated by Dassault, for export; similar in structure to F-15A Eagle
.	1967	1969	..	..	500	..	..	Production line to operate until 1980 due to new export orders
.	1975	..	..	..	..	..	..	Designation: Mirage-3E with P thrust increased by 16%
.	1967	1969	..	..	..	..	..	Designation: Mirage-3E; version for Egypt
977	..	..	..	..	..	42.6	2.1	Relaunch of production line planned with first delivery within 2 years; for training/coastal patrol; R&D cost: for relaunch of production
.	..	..	..	..	..	42.6	3.2	
968	1969	1970	40	..	247	..	..	Developed to meet Indian requirement for high-altitude hel for mountain warfare
.	1959	1969	48	..	1 362	..	..	Designation: Alouette-3
.	1967	..	..	..	..	..	..	Designation: Alouette-3; equipped with Astazou P
975	..	1980	..	..	..	..	..	Interim version in Super Puma project
975	..	1980	..	..	..	..	..	Interim version in Super Puma project; for delivery in 1980
970	1972	1976	..	..	..	..	..	
.	1978	..	..	..	..	..	..	
973	1975	1978	..	..	..	..	..	First delivery planned for early 1978
978	1979	..	..	..	..	..	..	
.	1974	1978	12	12	..	..	..	First order of 50 for navy to be delivered by Sep 1980; total requirement: 71; to replace Etendard-4M
.	1965	1966	12	..	85	..	..	Version SA-321H for army and AF; version SA-321G for navy
978	1979	..	..	..	..	..	..	

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	Panhard	AML-245	AC	P: D Gun MG	Fra Fra Fra		6	100	600
	Roanne	AMX-32	MBT	Gun Cann	Fra Fra	1 1	..	..	..
	Giat	AMX-10P	AC	Gun	Fra	1	13	65	600
	Giat	AMX-10RC	Recce	P: D Gun MG	Fra Fra Fra	 1	15	85	800
	Roanne	AMX-155	SPG	P: D	Swi		41	60	450
	Roanne	AMX-30	MBT	G MG	Fra Fra		36	65	600
	Creusot-Loire	AMX-VCI	ICV	P: D	Fra		4	65	400
	Roanne	AMX-30S	MBT	P:	Fra		36	60	600
	Panhard	M-3	APC	P: D MG	Fra Fra		6	100	600
	Panhard	M3-VDA	AAV	P: D Gun MG	Fra Fra Fra		6	100	600
	Saviem/Creusot	VAB	APC	P: D	Fra		13	100	1 300
	Berliet	VXB-170	APC	P: D	Fra		13	85	750
	Aérospatiale	AM-10 LASSO	AShM	P: S			28	990	11
	Aérospatiale	AM-39 Exocet	ASM	P: S	Fra		165	..	50
	Aérospatiale	AS-11	ASM	P: S	Fra		2	576	3
	Aérospatiale	AS-12	ASM	P: S	Fra		30	..	8
	Aérospatiale	AS-15	AShM	P: S	Fra		28	1 008	15
	Aérospatiale	AS-15	AShM	P: S	Fra		28	1 008	15
	Aérospatiale	AS-20	ASM	P: S	Fra		30		..
	Aérospatiale	AS-30	ASM	P: S	Fra		230	1 800	12
	Aérospatiale	AS-30L	ASM	P: S	Fra		250	1 800	12
	Aérospatiale	..	ASM				..	..	100

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1959	1961	1961	..	..	400	..	..	
..	..	..	..	..	..	..	..	
1965	1969	1973	..	..	..	..	..	
..	..	1977	..	..	..	..	..	
1970	1973	1974	..	..	..	..	..	
1957	1960	1966	240	..	1 445	..	5.2	
1954	1955	1956	..	..	..	..	..	Based on modified AMX-13 chassis
..	1975	..	..	..	..	..	..	Special version developed for Middle East with laser rangefinder
..	1969	1971	..	..	..	..	..	
..	1975	1976	..	..	..	..	..	
1969	1974	1975	..	..	..	..	..	First pre-production vehicle completed; army requirement: 4 000
1965	1969	1973	..	..	..	..	..	Army requirement: 400
1977	1978	..	..	..	..	..	..	Development announced 1977; to replace AS-12
..	1973	1976	..	..	..	..	..	Developed for Super Frelon hel; total orders for MM-39/AM-39 by Apr 1978: 1 150
..	..	1962	..	..	167 000	..	..	
..	..	1962	..	..	..	..	..	
1976	..	..	..	..	..	..	..	Development announced in 1976
1978	1978	..	..	..	..	..	..	All-weather version; planned
..	..	..	..	..	5 737	..	..	Production completed 1978; 2 triple launchers/aircraft; total orders by Apr 1978: 5 737, including AA-20 version
..	..	..	..	3 850	..	..	..	
..	1977	..	..	..	..	..	..	Developed for Jaguar; flight trials 1977 in cooperation with Martin Marietta, USA; NATO orders expected
1978	..	1982	..	..	..	108	..	Government authorized development in Mar 1978; R&D contract for $108 mn; for Mirage-2000 from 1985

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Thomson/Matra	Crotale	Landmob SAM	P: S	Fra		15	2	8
	Thomson/Matra	Crotale Naval	ShAM	P: S	Fra		15	1	8
	..	Flash	ShAM				..	..	..
	Aérospatiale	M-20	SLBM	P: S			..	..	3 000
	Aérospatiale	M-4	SLBM	P: S	Fra		..	..	4 000
	Aérospatiale	MM-38 Exocet	ShShM	P: S	Fra		165	..	42
	Aérospatiale	MM-40 Exocet	ShShM	P: S	Fra		165	..	70
	Aérospatiale	MM-40 Exocet CD	Landmob SShM	P: S	Fra		165	..	70
	Latercoere	MQ1 Malafon	ShSuM	P: S	Fra		100	828	13
	Matra	R-530	AAM	P: S	Fra		27	3	18
	Matra	R-550 Magic	AAM	P: S	Fra		..	..	10
	Aérospatiale	S-3	IRBM	P: S			..	..	3 000
	Thomson/Matra	Shahine	Landmob SAM				..	..	..
	Aérospatiale	SM-39 Exocet	SuShM				..	..	50
	Aérospatiale	SS-11	ATM				..	..	3
	Aérospatiale	SS-12	ShShM				..	..	6
	Army	Super Pluton	SSM				..	..	240
	Matra	Super R-530	AAM				..	3 672	..
	Lorient	A-69 type	Frigate	P: D Cann RL ShSh TT	 Fra 	 3 1 2 4	1 170	24	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1964	1965	1968	..	..	2 000	..	..	R&D financed to 85% by South Africa (S. African version: Cactus); 4-round launcher on vehicle; French designation: R-440
1974	1976	1978	..	..	..	..	..	8-round launcher; French designation: R-460
1976	..	..	..	..	..	..	..	Being studied; for use against sea-skimming anti-ship missiles; French industry seeking international partners before proceeding with development
..	..	1976	..	..	(64)	..	..	First operational on 4th N sub in 1977; replacing M-1 and M-2 on 3 earlier N subs and will be fitted on 5th by mid-1979
..	1979	..	..	..	..	..	..	To arm nuclear submarines by 1988
1967	..	1972	..	..	1 100	..	..	Exported to 17 navies
..	..	1977	..	..	..	..	..	4 MM-40 launchers can be mounted in the space needed for 1 MM-38
..	1979	1979	..	..	..	..	..	
1956	..	1962	..	..	..	..	..	
1958	..	1963	..	..	..	..	..	For Mirage-3 and Mirage F-1; to be replaced by Super R-530 from 1978
1968	1972	1974	1 200	..	3 300	..	..	R&D costs to date: $40 mn
1973	1976	..	..	..	..	456	..	To replace S-2 from 1980, using same silos
1975	1977	1980	..	..	..	..	..	Version of Crotale; developed to meet Saudi requirement; 6-round launcher on AMX-30 chassis
..	..	..	..	..	..	..	..	
..	.	1962	..	..	170 000	..	..	Vehicle- or ship-launched from ramp; also with ground launcher; ~170 000, including AS-11 airborne version and Harpon ATM, delivered to more than 20 customers
..	..	1966	..	..	2 000	..	..	Shipborne version has more than twice range of SS-11; for fast patrol boats; coastal defence version also deployed
1978	..	..	..	..	..	..	..	
1971	1973	1977	..	..	..	..	..	For Mirage F-1 from 1978 and Mirage-2000
1972	1973	1975	5	14	..	..	36.0	First 9 to be completed 1978–81; 2 sold to South Africa embargoed

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	CMN Cherbourg	Agosta class	Sub	P: D			120	20	..
				TT		4			
	Dubigeon	Batral type	Transport	P: D	Fra		750	16	3 500
				Mort		2			
				Hel	Fra	1			
	DTCN	C-1800	Corvette	ShAM	Fra	8	2 000	31	..
				ShSh	Fra	12			
				ShSh	Fra/ Italy	8			
				Cann	Swe	2			
				Hel	Fra	1			
	Brest	C-70 type	Destroyer	P: GT	UK		3 800	30	..
				Cann		7			
				ShAM	USA	1			
				ShSh	Fra	4			
				ShSh	Fra	1			
				TT	Fra	10			
	La Perrière	Chamois type	Tender	P: D			400	14	..
	CMN Cherbourg	Combattante-2	FPB	P: D			255	40	..
				Cann	Italy	1			
				Cann	Italy/ Swe	2			
				ShSh	Fra/ Italy	4			
	CMN Cherbourg	Combattante-3	FPB	P: D	Fra/ Italy		418	32	..
				Cann	Italy	1			
				Cann	Italy/ Swe	2			
				ShSh	Fra	4			
	DTCN	FL-2500	Frigate	ShAM	Fra	8	3 000	30	..
				ShSh	Fra	12			
				ShSh	Fra/ Italy	8			
				Hel	Fra/ UK	1			
	CMN Cherbourg	Kaman class	FPB	P: D	FRG		249	30	700
				Cann	Italy	1			
				Cann	Swe	1			
				ShSh	USA	4			
		L'Inflexible	NBMS	P: N	Fra		..	..	..
	CMN Cherbourg	Le Redoutable	NBMS	P: N	Fra		7 500	25	5 000
				SLBM	Fra	16			
				TT	Fra	4			
	CMN Cherbourg	P-32 type	CPB	P: D			90	29	1 500
	Brest	PA-75	Nucl aircr carrier	P: N	Fra		16 400	28	..
				Cann	Italy/ Swe	2			
				Cann		2			
				Hel	Fra/ UK	25			
				ShAM	Fra	2			
				ShAM		4			

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1972	1974	1977	2	..	4	..	..	
1977	..	..	..	..	..	..	..	Capacity: 140 men, 12 vehicles, 1 hel
..	..	..	..	..	..	..	..	Arms: 12 × Exocet, 8 × Otomat, 8 × Crotale, 2 × 40-mm Bofors cannon
1974	1975	1979	..	10	..	..	..	
..	..	1976	1	4	..	..	..	
1971	..	1972	..	..	..	..	..	
1975	..	1976	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1975	1976	1977	2	12	..	..	..	Version of Combattante-3 for Iran
1982	..	..	..	..	..	..	..	Originally 6th ship of Redoutable-class, but delayed until 1982; will now be leadship of improved class
1964	1967	1971	..	..	5	..	..	
..	..	..	..	..	..	..	..	
1981	..	..	..	3	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	SFCN	PR-72 type	FPB	P: Cann Cann Cann ShSh	Fra Italy Italy/ Swe Swi Fra	 1 2 2 4	445	28	..
	CNIM	PS-700 type	LST	P: D			2 800	15	..
	Cherbourg	SNA-72 type	Nucl sub	P: N TT	Fra Fra	 4	2 385	25	..
	..	Tecimar type	GB	P: D MG	 Fra	 2	30	25	..
4 FR Germany	RFB	Ati-2	Trainer	P: TS	USA		..	..	..
	MBB	Bo-105M	Hel	P: TS	USA		..	270	..
	MBB	Bo-105P	Hel	P: TS ATM	USA Fra/ FRG	 6	..	..	..
	MBB	Bo-108	Hel				..	..	..
	Dornier	Do-24/72	Flying boat	P: TP	USA		10 407	416	3 200
	Dornier	Do-28D-2	Transport	P: PI	USA		2 298	325	2 020
	Dornier	Do-28D-5	Transport				..	..	..
	Krauss-Maffei	Gepard	AAV				45	65	..
	Krauss-Maffei	Leopard	ARV				42	65	800
	Krauss-Maffei	Leopard	BLT				42	65	600
	Krauss-Maffei	Leopard-1-A4	MBT	Gun MG	UK FRG		42	65	600
	Krauss-Maffei	Leopard-2	MBT				50	68	..
	Krauss-Maffei	Leopard	AEV	MG AA	FRG Italy		41	65	850
	Rheinstahl	Marder	APC	P: D Cann MG	FRG FRG FRG		28	75	520
	Rheinstahl	Spähpanzer-2	Recce AC	Cann MG	FRG FRG		20	90	800

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1974	1975	1976	..	..	..	..	..	
..	1977	1978	..	..	..	..	..	Capacity: 240 troops and 11 tanks
1976	..	1981	..	5	..	..	..	2 squadrons planned; great reduction in size of reactor compared to Redoutable-class
..	..	1974	..	..	..	..	..	
1970	1978	1979	..	..	..	..	..	First prototype known as AWI-2; competing with SF-260, PC-7; production decision expected end-1978; version AWI-4 under consideration
1962	1966	1971	..	..	..	..	0.9	To enter service in 1979; replaces Alouette-3; army order: 100 to meet VBH requirement (liaison and observation)
..	1977	1978	20	..	..	..	..	Delivery to army began 1978; arms: 6 × HOT; to meet PAH requirement (anti-tank helicopter)
1977	..	..	..	..	..	..	..	12- to 14-seat hel; similar to BK-117 project
1977	..	..	..	..	..	..	..	Version developed to meet Spanish AF requirement for replacement of HU-16; production decision depends on export orders
..	1966	1968	30	330	..	..	..	Dornier repaid government development loan of $27 mn
..	1978	..	..	..	..	..	0.5	New prototype to cost 10% more than D-2 version
1966	1969	1975	..	..	..	..	1.7	
..	..	1966	..	..	..	..	..	
..	..	1973	..	..	..	..	..	
..	..	1970	..	..	..	..	..	
1969	..	..	..	..	..	..	..	Undergoing tests in FRG and USA: to replace M-48 Patton
1976	..	..	..	..	..	..	..	Most components identical to Leopard ARV; specially designed for river-crossing
1959	1964	1971	..	..	..	..	..	
1964	1971	1973	..	..	..	..	..	Total order by FRG Army: 408 at $142 mn; to replace Hotchkiss-11-2

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Krauss-Maffei	Spähpanzer-3	Recce AC	P: D Cann MG	FRG FRG FRG		11	90	800
	Rheinstahl	UR-416	APC	P: D MG	FRG FRG		6	80	700
	Rheinstahl	Waffenträger 11	LT				16	..	..
	MBB	Cobra-2000	ATM	P:	Swi		2	300	2
	MBB	Mamba	Landmob/ Port ATM	P: S			2	..	2
	Blohm-Voss	..	Frigate				..	..	..
	Lürssen	Jaguar-2 class	FPB	P: D	FRG		270	40	..
	Lürssen	Jaguar-3 class	FPB				410	36	..
	Abeking	SAR-33 type	FPB	P:	FRG		190	40	..
	Bremer Vulcan	Type 122	Frigate	P: GT Cann RL ShAM ShSh	USA/ FRG Italy USA USA	 1 1 8 8	3 800	30	..
	Howaldtswerke	Type 209	Sub	P:	FRG		980	22	..
5 German DR	..	Froesch class	LST	P: D			1 950	18	..
	Peenewerft	Kondor-2 class	Coast minesweeper	P: D Cann		 6	245	21	..
	..	Libelle class	TB	P: D Cann		 4	30	40	..
4 Greece	..	LCP type	CPB				..	..	..
	Skaramanga	..	TB				75	28	..
	Salamis	..	Training				3 200	..	..
7 Ireland	..	Timoney	APC	P: D	Ireland		8	98	483
	Verolmecork	Deirdre type	Corvette	P: D Cann	UK Swe	 1	1 020	12	5 000
4 Italy	Agusta	A-109 Hirundo	Hel	P: TS	USA		1 360	311	705
	Agusta	A-129 Mangusta	Hel	P: TS ATM MG Rock	USA USA Italy Italy	 8	2 909	300	..
	Aeritalia	G-222	Transport	P: TP	USA		14 590	540	4 950

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	..	..	..	..	..	..	
..	1965	1969	..	..	..	..	..	
1974	..	..	..	..	..	..	..	Projected by Rheinstahl and Porsche; air-transportable by C-160F Transall
1957	..	1960	..	..	200 000	..	..	2 versions in production since 1960; delivered to 18 armies including licence production in Brazil, Italy, Pakistan and Turkey; no container
..	1972	1974	..	..	..	..	..	
1978	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1976	1978	..	..	..	..	..	..	
..	..	1981	..	6	..	..	..	Arms: Harpoon, Seasparrow and Stinger
1971	1973	1974	..	..	28	..	..	
..	..	1975	2	..	(4)	..	..	
..	..	1971	4	..	(30)	..	..	
..	..	1975	2	..	(7)	..	..	
1977	..	..	..	14	..	..	..	
..	1977	..	..	10	..	..	..	
1976	1978	..	..	1	..	..	..	
1972	1973	..	..	..	..	..	..	For UN force and army; licence produced by Belgium
..	1971	1972	1	3	..	..	9.6	
1971	..	1975	..	..	5	..	..	R&D funding allocated; delivery planned for 1981
1978	1979	..	..	..	..	..	..	Project definition completed; development of A-109; delivery planned for 1981; night/all-weather capacity
..	1970	1974	..	..	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Aeritalia	G-222L	Transport	P: TJ	UK		..	..	..
	Aermacchi	MB-326K	Trainer	P: TJ	UK		3 123	1 003	2 130
	Aermacchi	MB-326L	Trainer	P: TJ	UK		2 694	942	..
	Aermacchi	MB-339	Trainer/ground attack	P: TJ AAM ASM MG Cann Rock	UK Fra Fra	 2 2	3 075	971	2 110
	SIAI-Marchetti	S-211	Trainer	P: TF	Can		1 420	639	2 000
	SIAI-Marchetti	SF-260C	Trainer/COIN				..	..	..
	SIAI-Marchetti	SF-260SW	Mar patrol	P: PI	USA		775	436	..
	SIAI-Marchetti	SF-260W Warrior	Trainer/COIN	P: PI	USA		755	340	1 440
	Fiat	Fiat-6614	APC	P: D MG	Italy Italy		7	96	700
	Oto Melara	OF-24 Tifone	MICV	P: D Gun MG	Italy Italy Italy	 1 3	23	70	500
	Fiat/Oto Melara	Type-6616M	AC	P: D	Italy		7	95	750
	Selenia	Aspide-1A	AAM	P: S	Italy		..	2	..
	Selenia	Aspide/Albatros	ShAM/ShShM				..	..	..
	Selenia	Aspide/Spada	SAM				..	..	..
	Sistel	Indigo	Landmob SAM	P: S	Italy		21	2	10
	Galileo/Sistel	Indigo-Mei	Landmob SAM				..	..	..
	Sistel	Mariner	ShShM				70	1 080	25
	Oto Melara/Sistel	..	ShShM				..	..	200
	Sistel	Seakiller-2	ShShM	P: S	Italy		70	..	25
	Sistel	Seakiller/Marte	AShM				70	..	20
	Breda Meccanica	Sparviero	ATM	P: S			4	504	3

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	1979	..	..	..	..	..	..	New version for Libya with Rolls-Royce P to get round US export restrictions
..	1970	..	..	..	..	..	..	
..	1973	1974	..	..	..	..	..	
1974	1976	1977	..	..	..	..	..	Government funded 100 aircraft at $144 mn (1977 prices); licence-built Rolls-Royce P
..	1981	..	..	..	..	..	..	
..	1970	..	240	..	..	..	0.1	Current production version
..	1977	..	..	..	..	..	0.2	Version of Warrior; production rate for all SF-260 versions: 20/month
..	1970	1974	240	..	..	..	..	
..	..	..	..	..	..	..	..	
1975	..	..	..	..	..	..	..	Based on Swiss Mowag; design announced in 1975
1970	1973	..	..	..	..	..	..	
1969	1974	1977	..	..	..	..	..	For high-performance interceptors and for Albatros ShAM system
1969	1974	1977	..	..	..	..	..	1 system consists of launcher, fire control, cannon, Aspide-1A AAM; first version used Sparrow ShAM but was never deployed
..	..	1978	..	..	..	..	..	Second-generation short-range system; tests completed in 1977; delivery planned for 1979; 1 fire unit has 3 8-round missile launchers on M-548/Fiat TM-69 vehicles
..	..	1971	..	..	..	..	..	
1971	..	..	..	..	..	..	..	At advanced development stage; army evaluation in 1977; launcher vehicle: M-548
..	..	..	..	..	..	..	..	
1978	..	..	..	..	..	..	..	
1965	1969	1972	..	..	..	..	..	Deck-fixed launchers or multiple launcher; also used in Marte hel-launched ASM system
..	..	1978	..	..	..	..	..	Designation is name of system; hel-launched version of Seakiller-2 missile; for SH-3D
1978	..	1985	..	..	..	..	..	

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	Oto Melara	Vanessa	ShAM				..	..	..
	Breda-Mestre	Anteo Salvage	..	P: D	Italy		3 200	19	4 000
				Hel		1			
				Ship		4			
	Breda	..	FPB	ShSh	Fra	4	255	36	..
				Cann	Swe	1			
	Riuniti	..	Corvette				650	..	..
	Italcantieri	Garibaldi	Aircr carrier	P: GT	Italy/ USA		10 100	29	7 000
	Rine	..	GB	P: D	FRG		165	35	..
				Cann		3			
	Tirreno	Lupo class	Frigate	P: GT	Italy		2 900	34	..
				Cann	Italy	5			
				RL		2			
				ShAM	USA	8			
				ShSh	Fra/ Italy	8			
				TT	USA	6			
	Riuniti	Maestrale class	Frigate	P: GT	Italy		2 500	30	4 500
				Cann	Italy	5			
				Hel	Italy/ USA				
				Son	USA				
				ShAM	Italy	4			
				ShSh	Italy	4			
				TT	USA	6			
	Intermarine	..	Minesweeper	P: D			470	12	2 500
				Cann		1			
				Son	Italy				
	Italcantieri	Sauro class	Sub	P: D	Italy		1 456	20	..
				TT		6			
	Riuniti	Sparviero class	Hydrofoil FPB	Cann	Italy	1	62	50	400
				ShSh	Fra/ Italy	2			
	Tirreno/Riva	Stromboli type		P: D	Italy		3 556	20	..
				Cann	Italy	1			
				Cann		2			
				Hel					
10 Japan	Kawasaki	C-1	Transport	P: TF	USA		23 320	806	3 353
	Mitsubishi	F-1	Fighter/close support	P: TF	Fra/ UK		6 358	1 958	1 112
				AAM	Japan	4			
				AShM	Japan				
				Cann		1			
	Fuji	KM-2B	Trainer	P: PI	USA		1 120	413	965
	Mitsubishi	MU-2 Marquise	Transport				..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	..	1985	..	..	..	..	..	
1977	1978	1979	..	..	1	..	..	Weight: full-load
..	..	1979	..	..	..	..	..	
1978	..	..	..	..	..	..	..	
1980	..	1984	..	1	..	..	..	Ordered in 1977 to replace *Andrea Doria*
..	..	1978	3	..	3	..	..	
1974	1976	1977	1	..	4	..	..	4 exported to Peru, 6 to Venezuela; arms: Otomat Teseo, Albatros, NATO Seasparrow
1978	1980	1980	..	6	..	..	..	First 6 ordered in 1976; extra government funding provided in 1975
978	..	..	..	10	..	..	..	
974	1976	1978	2	4	..	..	..	
.	1973	1974	..	7	..	..	..	
973	1975	1975	1	..	2	..	..	Weight: full-load
966	1970	1973	..	24	..	1.9	..	R&D in FY 1978: $1.89 mn; planned versions: ECM, minelayer, recce, tactical transport
972	1975	1977	..	26	..	..	..	First 26 ordered in 1976 and on 15 Mar 1977; FY 1978 funding: $163.35 mn
974	1974	1976	6	..	12	..	..	Local development of US designation T-34A; for use as primary trainer; FY 1978 funding: $9.52 mn for 14
.	..	1978	..	..	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Rang
	Mitsubishi	MU-2 Solitaire	Transport				..	..	..
	Shin Meiwa	PS-1	Flying boat	P: TP Bomb TT Rock	USA		4 744	..	..
	Mitsubishi	T-2A	Trainer	P: TF AAM Cann	Fra/ UK		6 301	1 958	2 593
	Shin Meiwa	US-1	Flying boat	P: TP Bomb Rock TT	USA		23 300	426	4 207
	NAMC	YS-11E	Trainer				..	..	..
	Mitsubishi	Type-67	AEV	MG	Japan	1	35	..	..
	Mitsubishi	Type-70	ARV	MG Mort	Japan Japan	1 1	35	..	..
	Mitsubishi	Type-73	MICV	P: D MG	Japan Japan	 2	..	60	..
	Mitsubishi	Type-74	MBT	Gun MG	Japan Japan	1 2	38	53	500
	Mitsubishi	ASM-1	AShM				..	..	..
	Kawasaki	KAM-3D	Landmob/port ATM	P: S			..	..	1
	Kawasaki	KAM-9	ATM	P: S			1	..	2
	..	..	SAM				..	..	..
	Toshiba	TAN-SAM	SAM				..	2 448	..
	..	XSSM-2	SShM/SSM				..	..	..
	Mitsubishi	AGS type	Survey	P: D			2 000	16	..
	Mitsubishi	Akizuki class	CPB	P: D	Japan		74	22	220
	..	Bihoro class	PB	P: D Cann		 1	636	18	3 200
	Mitsubishi	DD-122 type	Frigate	P: GT Cann RL ShSh TT	UK Italy Swe USA	 1 1 4 6	1 200	..	..
	Mitsubishi	Improved Uzushio	Sub	P: D TT	Japan/ FRG	 6	2 200	20	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1978	..	..	..	..	..	
1966	1967	1968	..	..	15	..	..	
..	..	..	..	29	..	..	..	AF order: 29
1970	1974	1974	..	..	3	..	..	
..	..	1977	..	..	1	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1968	1970	1972	..	..	..	..	..	
1964	1969	1972	..	..	..	..	..	
1973	1977	1979	..	..	..	..	0.4	Under development for F-1 aircraft
1957	..	1963	..	..	..	..	..	
1964	1977	1980	..	..	..	..	..	
1978	..	1985	..	..	..	..	..	Designation unknown; Japan purchased Northrop drones for evaluation of new SAM
..	1977	1979	..	..	..	..	..	
1978	..	..	..	..	..	..	..	
1976	..	1978	1	..	1	..	..	
..	..	1974	1	..	9	..	..	For Maritime Safety Agency
..	..	1974	5	..	21	..	..	5 more ordered in 1977 for Maritime Safety Agency (16 completed by 1977)
1978	..	1981	..	8	..	..	..	Total number planned: 6–8 by 1981; arms: 2 × Harpoon ShShM, 1 × Seasparrow ShAM, 1 × 76-mm Oto Melara cannon, 1 4-round Bofors RL
1976	1978	1979	..	1	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Ishikawa Jima	Improved Haruna	Destroyer	P: GT			5 200	32	..
				Cann	USA	2			
				Hel		6			
				ShAM	USA	1			
				ShSh	USA				
				ShSu	USA	8			
				TT	USA	6			
	Hitachi/Nippon	..	Coast minesweeper	P: D			440	14	..
				Cann		1			
	Nippon	..	PB	P: D			3 750	20	5 500
				Cann		2			
				Hel	USA	1			
		..	Support	P: D			4 500	22	9 500
	Mitsubishi	..	Survey	P: D			3 050	14	..
	Mitsubishi	Tachikaze class	Destroyer	P: TE			3 900	33	..
				Cann	USA	2			
				Radar	Japan				
				Radar	USA				
				ShAM	USA	1			
				ShSu	USA	8			
	Hitachi/Nippon	Takami class	Coast minesweeper	P: D	Japan		380	14	..
				Cann		1			
	Kawasaki/ Mitsubishi	Uzushio class	Sub	P: D	Japan/ FRG		1 850	20	..
				TT		6			
	Sumitomo	Yamagumo class	Destroyer	P: D			2 100	27	7 000
				Cann		4			
				Cann	Italy	4			
				ShSu	USA	8			
				TT		6			
4 Netherlands	Fokker-VFW	F-27 Maritime	Mar patrol				..	..	..
	Fokker-VFW	F-27 MK-400	Transport	P: TP	UK		10 596	480	4 389
	Fokker-VFW	F-27 MK-500M	Transport	P: TP	UK		11 034	480	4 389
	Fokker-VFW	F-27 MK-600	Transport				..	..	..
	Fokker-VFW	F-28 MK-4000	Transport				..	..	..
	Fokker-VFW	F-28 MK-5000	Transport				..	611	..
	Fokker-VFW	F-28 MK-6000	Transport				..	..	..
	Fokker	F-29	Transport	P: TJ	UK		..	..	..
	De Schelde	Kortenaer class	Frigate	P: GT	UK		3 500	30	..
				Cann	Italy	2			
				Hel	Fra/ UK	1			
				ShAM	USA	1			
				ShSh	USA	8			
				TT		4			

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1977	1978	1980	..	2	..	..	..	Arms: 1 × Seasparrow ShAM, Harpoon, 8-cell ASROC launcher
1977	..	1979	..	3	..	..	..	
1977	..	1978	1	..	3	..	..	One delivered in FY 1977, 2 in FY 1978, for Maritime Safety Agency; arms: 1 Bell-212 hel
1977	..	1979	..	..	..	..	..	
1977	..	..	..	..	..	..	..	In production for South Africa
1973	1974	1976	..	..	2	..	..	
..	..	1969	2	..	19	..	..	In production 1969–78
1968	1970	1971	1	..	7	..	..	In production 1971–78
1964	1965	1966	1	..	6	..	..	Last of class, DD-121, completed in 1978, was to be leadship of new class, but replaced by DD-122 type
1975	1976	1977	..	..	662	..	..	Designation: MK-400; military version; production of MK-100 and MK-200 completed; carries 45 troops; total no. produced: all versions
..	1965	..	21	..	662	..	..	
..	1967	..	21	..	662	..	..	Versions in production: MK-400, 500, 600; carries 50 troops
..	1968	..	..	..	18	..	..	
..	1976	1976	16	..	..	..	..	
..	..	1974	..	..	..	..	..	
..	1973	1976	..	..	2	..	..	
1978	1984	..	...	..	..	..	..	
1975	1976	1978	1	12	..	..	85.0	4 more planned; arms: 1 Lynx hel, 8 × Harpoon, NATO Seasparrow ShAM, 1 × 76-mm Oto Melara cannon

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Rotterdam/Wilt	..	Sub				..	..	..
	Wilton Fijenoord	Wilton type	FPB	ShSh	Fra		1 500	..	..
4 Norway	Kongsberg	Penguin	ASM				..	..	..
	Kongsberg	Penguin CDS-1	Fixed/mob SShM				120	..	20
	Kongsberg	Penguin-2	ShShM	P: S Guid	Nor Swe		120	..	..
	Bergens/Westermoen	Hauk class	FPB	P: D Cann ShSh TT	FRG Nor 	 2 6 4	120	34	440
	Horten	Horten class	Sub tender	P: D Cann Hel		 2 1	2 500	16	..
	Bergens/Westermoen	Hugin class	FPB	P: D Cann Elec ShSh	FRG Swe Swe Nor	 1 6	140	35	..
	..	..	FPB	P: D ShSh	 Nor		1 940	23	..
	..	..	Support				..	..	..
	Mjellem-Karlsen	Vidar type	Coast minelayer	P: D Cann		 4	1 500	15	..
10 New Zealand	..	..	Survey				..	..	..
	Whangarei	..	Tender				..	..	..
5 Poland	PZL-Mielec	Iskra-200	Trainer	P: TJ Bomb Cann Rock	Pol		2 560	600	1 250
	PZL-Swidnik	Mi-2 Taurus-2	Hel	P: TS	USSR		3 356	190	170
	Gdansk	Ropucha class	LST	P: D Cann		 4	2 500	18	..
	..	Wisla class	FPB	P: D Cann TT		 2 4	70	30	..
4 Portugal	..	Spartacus type	PB				194	12	..
	Ars do Alfeite	..	Survey	P: D			1 140	15	..
5 Romania	Rom. State Fact.	TAB-70	APC	P: D MG	Rom Rom	 1	10	55	400
7 Spain	CASA	C-101	Trainer/ground attack				2 980	979	4 000

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1979	..	..	..	..	..	..	..	
1976	..	..	..	..	..	..	..	
1974	..	..	..	..	..	..	..	
1976	..	..	..	..	..	..	..	Coastal defence version of Penguin-2
1969	..	..	..	..	..	..	..	Long-range version of Penguin-1; studies under way for radar-homing and airborne versions
1976	1977	1977	..	14	..	..	..	Joint design by Norwegian/Swedish navies; development of Jägaren class
1977	1977	1978	1	..	..	..	15.3	Weight: full-load; to serve submarines and fast attack craft
1975	..	1977	1	17	..	..	..	Formerly known as Jägaren class
..	..	1980	..	4	..	..	..	Total number planned: cut from 7, 1977; for Coast Guard
1978	..	..	..	..	..	..	..	New class; to operate deep-diving vehicles
1976	1977	1977	1	..	2	..	..	Weight: full-load
1978	..	..	..	2	..	..	..	
1977	..	..	..	..	1	..	..	
1975	1976	1976	25	400	..	..	..	Production of Iskra-100 completed; version 200SB in use for armaments training
..	1974	1975	..	..	..	..	..	Development, production and marketing rights handed over to Poland in 1964 by USSR, to be introduced into Soviet AF
..	..	1972	2	..	11	..	..	
..	..	1972	2	..	15	..	..	Weight: full-load
..	1977	..	..	..	3	..	..	
1977	..	..	..	..	1	..	..	
..	..	1970	..	..	..	..	..	Local development of Soviet-designed BTR-60
1975	1977	1979	..	..	..	22.0	..	Programme cost for first 80 for Spanish AF: $95 mn; first delivery expected in 1979–80

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	CASA	C-212-10	Transport	P: TP	USA		..	..	..
	CASA	C-212A Aviocar	Transport	P: TP			3 700	359	1 760
	Bazan	Barcelo class	PB	P: D Cann	FRG	 3	139	40	1 200
	Bazan	F-30 class	Frigate	P: D Cann Cann RL ShAM ShSh TT	Spain/ FRG Italy/ Swe Italy Swe USA Fra/ USA	 2 1 1 8 8 6	1 200	26	4 000
	Bazan	..	Hel carrier				..	..	..
	Bazan	Mod Lazaga	FPB	P: D	FRG/ Spain		420	28	6 100
7 Sweden	Saab	B3LA	Fighter	P: TF			..	..	..
	Saab-Scania	Saab Supporter	Trainer/ground attack	P: PI	USA		646	260	..
	Saab-Scania	SK38/A38	Fighter				..	..	..
	Saab-Scania	Viggen A-20	Fighter				..	..	..
	Saab-Scania	Viggen AJ-37	Fighter	P: TF AShM Cann AAM	USA Swe Swi UK	 1	..	2 448	..
	Saab-Scania	Viggen JA-37	Fighter/interc	P: TF AAM AShM Cann	USA UK Swe Swi		..	2 448	..
	Saab-Scania	Viggen SF-37	Recce	P: TF AAM AShM Cann	USA UK Swe Swi		..	2 448	..
	Saab-Scania	Viggen SK-37	Trainer	P: TF AAM AShM Cann	USA UK Swe Swi		..	2 448	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1979	..	..	..	..	..	New version of Aviocar to enter production at 138th aircraft
1968	1971	1972	48	..	126	..	..	Number produced to date, including 71 for Spanish AF
1976	..	1978	2	..	2	..	..	
1974	1975	1978	3	8	..	..	..	Design is improved Joao Coutinho, formerly reported as Descubierta; 4 for Morocco; weight: full-load; arms: 8 × Seasparrow ShAM, 2 × Breda-Bofors 40/70-mm cannon, 1 × 375-mm Bofors RL
1978	..	1984	..	1	..	..	..	Design from Gibbs & Cox, USA; to be completed 1982–84
1977	..	..	..	4	..	..	..	Weight: full-load; arms: 1 × 76-mm Oto Melara cannon
..	1982	1985	..	..	..	..	..	Funding: $86.58 mn allocated for 1978 to mid-1979 for completion of project definition: P: US or UK engine to be selected; production decision expected in 1979
..	1972	..	..	..	..	..	..	Designation: MFI-17; developed from MFI-15, used in Biafra; license production in Pakistan
..	..	1985	..	..	..	2 950.0	..	Design is modified B3LA, proposed in 1978 to rescue Swedish aircraft industry; production decision expected in 1979
..	..	..	..	..	..	..	..	Proposed development of Viggen JA-37 instead of B3LA; decision on development expected in 1979
1962	1967	1971	..	..	..	..	..	Initial production version replaced Lansen from mid-1971; to be replaced by A-20 in 1985
1968	1974	1974	..	..	..	..	..	Arms: Sky Flash AAM, 1 × 30-mm Oerlikon cannon
..	1973	1976	..	..	..	..	..	
..	1970	1972	..	..	..	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment			Technical data		
				Type	Country	Number	Wt	Speed	Range
	Saab-Scania	Viggen-37X	Fighter/interc	P: TF	USA		..	2 448	..
	Hägglund	IKV-91	LT	P: D Gun MG	Swe Swe Swe	 1 2	15	69	550
	Saab	RB-04E	AShM				..	..	20
	Saab	RB-05A	AAM/AShM/ ASM	P: LP			..	..	9
	Bofors	RB-53 Bantam	ATM				7	..	2
	Saab	RB-83	ASM				..	..	..
	Bofors	RBS-70	Port SAM				1	..	5
	..	A-17 class	Sub				..	..	..
	..	Gassten	Inshore minesweeper				135	..	..
	Karlskrona	..	Minelayer	Cann Hel		4	3 000	..	..
	Kockums/ Karlskrona	Näcken class	Sub	P: D TT		 8	980	20	..
	Karlskrona	Spica class	FPB	P:D Cann TT	FRG Swe Swe	 1 6	250	..	..
		..	Survey	P: D			..	14	..
7 Switzerland	FFA	AS-202 Bravo	Trainer	P: PI	USA		665	227	935
	Farner-Pilatus	MBB-223K	Trainer				685	222	500
	Pilatus	PC-6	Transport	P: TP	USA		1 185	280	1 680
	Pilatus	PC-7	Trainer	P: TP	Can		1 280	440	110
	Mowag	Tornado	MICV	P: D Cann MG	Swi Swi Swi		20	70	600
	Mowag	Grenadier	AC/APC	P: D	Swi		6	100	550
	Mowag	Piranha	APC	P: D	Swi		9	100	1 000
4 Turkey	Taskizak Yard	Nasty class	TB	P: D			63	44	450
4 UK	..	AST-403	Fighter	P:	UK		..	..	..
	BAC	BAC-167	Trainer/COIN	P: TJ	UK		2 810	834	2 224
	Britten-Norman	BN-2A Defender	Transport	P: PI	USA		1 682	265	2 772

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1968	1974	..	..	..	..	..	..	Proposed export version, but no deals concluded in 1978
..	..	1974	..	..	..	..	..	
1968	..	1973	..	..	..	..	..	
1960	1968	1971	..	..	..	..	..	
1956	..	1963	..	..	..	..	..	In large-scale production for Swedish and Swiss armies
1977	..	..	..	..	..	85.7	..	
1969	1973	1976	..	..	..	..	..	
..	..	1985	..	..	..	..	..	At design stage for completion in mid-1980s
..	..	..	..	..	..	..	..	Weight: full-load
1977	..	1980	..	1	..	..	..	
1972	1975	1977	2	..	3	..	..	
..	..	..	..	..	..	..	..	Weight: full-load; in production for Malaysia; arms: 4 × Exocet ShShM, 1 × Blowpipe ShAM, 1 × 57-mm Bofors cannon
1977	..	1979	..	1	..	..	..	
..	..	1971	..	..	34	..	..	
..	..	..	..	..	..	..	..	Designation: Flamingo; original FRG design, transferred to CASA, Spain and then to Farner, Switzerland
..	1965	1966	48	..	450	..	..	
1975	..	1977	..	..	..	..	..	Total sales by 1978: 38 plus 22 options; first production aircraft completed in 1978 for delivery to Burma
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	1976	..	..	..	..	..	
..	..	1990	..	..	..	..	7.7	NATO partners sought; u.c.: at 1977 prices for 300 aircraft
..	1967	..	10	..	156	..	..	
.	..	1971	75	..	750	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun-try	Num-ber	Technical data Wt	Speed	Range
	Scottish Aviation	Bulldog-120	Trainer	P: PI	USA		669	241	1 000
	Scottish Aviation	Bulldog-200	Recce	P: PI	USA		821	260	1 000
	Hawker Siddeley	HS Harrier-3	Recce	P: TF Cann Bomb Rock	UK UK UK UK	 1	5 533	1 187	3 148
	BAC/HS	HS Hawk-1	Trainer/ground attack	P: TF	UK/ Fra		3 647	1 432	..
	Hawker Siddeley	HS-125/700	Transport	P: TF	USA		5 747	808	3 558
	Hawker Siddeley	HS-146	Transport				..	..	..
	Hawker Siddeley	HS-748	Coast patrol	P: TP	UK		12 500	431	1 873
	Hawker Siddeley	HS-748-2A	Transport	P: TP	UK		12 247	448	3 205
	Hawker Siddeley	HS-748M	Transport				..	..	..
	Scottish Aviation	Jetstream-31	Transport	P: TP	USA		3 485	454	..
	NDN Aircraft	NDN-1	Trainer	P: PI	USA		830	323	..
	Hawker Siddeley	Nimrod-2	Mar patrol	P: TF	UK		39 000	926	9 265
	Hawker Siddeley	Nimrod-3	AEW				..	..	..
	Short	SD3-Mr Seeker	Transport	P: TP	Can		..	365	..
	Hawker Siddeley	Sea Harrier	Recce	P: TF AAM	UK USA		5 533	1 187	3 148
	Short	Skyvan-3M	Transport	P: TP	USA		3 356	445	..
	Britten-Norman	Trislander-M	Transport	P: PI	USA		2 631	249	1 205
	Westland	WG-34	Hel				..	..	..
	GKN Sankey	AT-105	APC				9	88	..
	Vickers/Royal	Chieftain	ARV	MG	UK	1	52	42	322
	Vickers	Chieftain	BLT				53	..	..
	Vickers	Chieftain-3	MBT	Gun MG	UK UK		54	..	400
	Vickers	Chieftain-5	MBT	Gun MG	UK UK		53	48	500

Year design begun	Year of first prototype test	Year in production	Current annual production rate	Total number planned	Total number produced	Development cost	Unit cost	Comments
1968	1969	1971	..	..	..	..	..	
1974	1976	1977	..	..	..	..	..	
..	1966	1968	20	..	270	..	6.0	Only operational NATO fixed-wing VSTOL fighter
..	1974	1976	72	..	85	..	..	Total number planned: 165 for AF, rest for export; production rate at end-1978: 6/month; 1-seat version planned
..	1976	1976	..	..	..	..	..	Designation: 700A for North America, 700B for rest of market
..	1980	..	..	..	..	..	..	
..	1977	1978	..	..	..	..	..	
1959	1960	1967	..	..	..	..	..	
..	..	..	..	..	28	..	..	
1978	..	1981	..	..	..	..	..	Relaunch of production; 3 new versions planned
1977	1977	..	..	..	..	..	..	Company set up in 1977 to develop own design
1975	..	1978	..	..	..	..	..	Basic production version for UK and export; production of Nimrod-1 completed
1977	1977	1980	..	11	..	767.0	..	RAF to receive first aircraft in 1981/82; R&D cost: 5-year estimate; first of 11 now at final assembly stage
..	1974	..	..	..	..	..	..	
1975	1978	1979	..	..	..	153.0	5.4	Versions 1 and T-4 in production; first delivery in 1979
..	..	1970	5	..	51	..	..	
1970	1970	..	..	..	..	..	..	Proposed military version of civilian Trislander-3
1978	..	..	..	..	..	..	..	Design study began; to replace Sea King
..	..	..	..	..	..	..	..	
..	..	1976	..	..	..	..	..	
..	..	1974	..	..	..	..	..	Developed to replace Centurion bridge layer
.	1959	1969	. :	..	2 500	..	..	In service with UK and Iran
..	1961	1971	..	..	..	..	..	Designation: Shir Iran-2 with Chobham armour; Isfahan ordnance complex to produce ammunition, etc. for Shir Iran; all versions produced today for export to Iran with delivery to start in 1979

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun-try	Num-ber	Technical data Wt	Speed	Range
	Vickers	Falcon	SPG	P: D Gun	UK Swi	 2	15	48	390
	Daimler	Ferret FV-703	AC	P: D ATM MG	UK UK UK		5	93	300
	Royal Ordnance	Fox	AC	Gun	UK	1	6	104	438
	Short	SB.301	APC	P: D	UK		3	96	368
	Alvis	Scimitar FV-107	AFV	P: D MG Cann	UK UK UK		8	87	644
	Alvis	Scorpion FV-101	Recce AC	P: D Gun MG	UK UK UK		8	87	644
	Short	Shorland	APV	P: D	UK		3	89	257
	Alvis	Spartan	APC	P: D MG	UK UK		8	87	644
	Alvis	Striker FV-102	AC	ATM MG	UK UK	5 1	8	..	..
	BAC	Beeswing	ATM				6	..	..
	Short	Blowpipe	Port SAM	P: S			2	..	3
	Vickers/Short	Blowpipe SLAM	SuAM/SuShM				2	..	3
	BAC	P3T	AShM				..	..	100
	BAC	Rapier	Landmob SAM	P: S			..	..	7
	BAC	Rapier Improved	Landmob SAM	P:	UK		..	..	..
	BAC	Sabre	ATM	Guid	USA		..	1 224	6
	HS Dynamics	Sea Dart Mk-1	ShAM/ShShM	P: SL			..	..	30
	BAC	Sea Dart Mk-2	ShAM/ShShM				..	..	80
	BAC	Sea Skua	AShM	P:	USA		35	..	14
	Short	Seacat	ShAM/ShShM	P: S			..	..	4
	BAC	Seawolf	ShAM/ShShM	P: S			150	2 448	5
	HS Dynamics	Sky Flash	AAM	P: S	USA		..	..	..
	HS Dynamics	SRAAM	AAM	P: S	UK		10	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	1970	..	..	..	..	..	..	Test programme completed
..	1950	1967	..	..	..	..	..	
1965	1967	1973	..	..	..	..	..	
..	1973	1974	..	..	..	..	..	
1964	..	1973	..	..	..	..	..	Air-portable version of Scorpion
1964	1969	1972	..	..	..	..	..	
..	1965	1965	..	..	..	..	..	
1964	1969	1974	..	..	..	..	..	
..	..	1972	..	..	..	..	..	
..	1978	..	..	..	..	..	..	
1966	..	1973	..	..	..	..	..	In production for UK and Canada
..	1972	1973	..	..	..	..	..	Tests completed in 1972; for Oberon and 500-/1 000-t submarines; offered for export
1977	..	1980	..	..	..	..	..	At project-definition stage; for Buccaneer, Tornado; night and all-weather capacity
1963	..	1967	..	..	8 700	..	..	Fixed ground launcher or M-548 tracked vehicle; tracked version produced in quantity for Iran; u.c. per battery:$20 mn–$52 mn
1978	..	1980	..	..	..	..	..	
1978	1978	..	..	..	..	..	..	
1962	1965	1967	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1970	1978	1980	..	..	..	..	..	
1958	1962	1962	..	..	..	..	..	Light-weight version specially developed for FPBs, sold to Iranian Navy; 3-round launcher; standard version sold to 14 navies, 4-round launcher
1965	1975	1977	..	..	..	..	..	Standard version uses 6-round launcher; versions for smaller ships with twin launcher: Seawolf/Ipsi, Seawolf/Delta, Seawolf/Omega
1973	1975	1977	..	..	1 350	..	..	
1972	1976	..	..	..	..	..	..	

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	BAC	Swingfire	ATM	P: S	UK		6	..	4
	Short	Tigercat	SAM	P: S			..	..	4
	Scott-Lithgow	AEFS type	Fleet repl	P: D Hel	 UK	 1	20 000	20	..
	Vosper/Yarrow	Amazon class	Frigate	P: GT Cann Hel ShAM ShSh TT	UK Swi Fra/ UK UK Fra 	 2 1 4 4 6	2 750	32	1 200
	Cheverton Cowes	Cheverton	PB				4	..	..
	Vosper	..	Frigate	Cann ShSh	UK Fra	1 4	2 950	..	..
	Vosper	..	Hovercraft	P:	UK		..	60	..
	Vosper	Hunt class	Coast minesweeper	P: D Mine	UK Fra	 2	615	17	..
	Vickers/Swan	Invincible	Aircr carrier/ ASW cruiser	P: GT Aircr ShAM	UK UK UK	 15 2	16 000	28	5 000
	Hall Russell	Island class	FPB	P: D Cann		 1	925	16	7 000
	Brooke Marine	..	Logistic	P: D	UK		2 000	..	..
	..	Loyal class	Tender/PB	P: D	UK		143	10	..
	Brooke Marine	RCT type	LST	P: D			870	10	4 000
	Swan Hunter	..	Fleet repl	Hel Cann G	 Swe Italy	3 4 1	10 890	21	..
	Vosper/Swan	Sheffield class	Destroyer	P: GT Cann Cann Hel ShAM TT	UK Swi Fra/ UK UK 	 1 2 1 2 6	3 150	30	4 500
	Yarrow	..	Support	P: D			2 500	..	..
	Vickers	Swiftsure class	Nucl sub	P: N SuSh TT	UK USA 	 5	3 500	30	..
	Swan Hunter	..	Repl tanker				10 890	19	..
	Fairey Marine	Tracker type	FPB	P:	FRG		..	29	..
	Vickers	Trafalgar class	Sub	SuSh	USA		..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1958	..	1968	..	..	..	..	..	Vehicle-, helicopter- or ground-launched; entered service with UK Army in 1969
..	..	1969	..	..	..	..	..	1 triple launcher on vehicle
1973	1976	1978	1	2	..	..	..	
1969	1971	1974	1	..	8	38.7	..	
..	..	..	..	..	..	..	..	
1978	..	..	..	7	..	..	..	
..	1978	..	..	..	..	..	..	
1975	1977	1978	1	2	..	..	..	
1973	1977	1979	..	2	..	320.0	..	Designation: Through-Deck-Cruiser; weight: full-load; capacity: 9 Sea King hel, 7 Sea Harrier aircraft
1975	1976	1976	1	7	..	6.3	..	
1977	..	1979	..	1	..	..	..	
..	..	..	..	10	..	..	..	Weight: full-load
1975	1976	1977	1	..	2	..	..	Weight: full-load; capacity: 350 t or 5 Chieftain MBTs
1976	1977	1978	1	..	1	..	..	Arms: 3 hel, 4 × 40-mm Bofors cannon, 1 × 76-mm Oto Melara cannon
1970	1971	1975	4	..	10	59.2	..	
1977	1979	1981	..	..	..	..	..	
1969	1971	1973	1	..	6	79.2	..	
1976	..	1978	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1978	..	..	..	2	..	..	..	All fleet submarines to get Subharpoon SuShM from 1980

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Vickers	Type 206	Sub	SLAM	UK		420	..	..
	Vosper	Vosper-9	Corvette	P: D ShAM RL Gun Cann	France UK Swe Italy Swi	 1 1 1 2	820	29	4 100
	Dunston	Water class	Water carrier	P: D			285	11	..
1 USA	Fairchild	A-10A	Fighter/close support	P: TF	USA		13 763	713	4 200
	Cessna	A-37B Dragonfly	Fighter/COIN	P: TJ	USA		2 817	787	..
	MDD	A-4M Skyhawk-2	Fighter-bomber	P: TJ	USA		4 747	1 038	3 307
	MDD	A-4N Skyhawk-2	Fighter-bomber	P: TJ	USA		4 747	1 040	3 307
	Grumman	A-6E Intruder	Fighter/ASW	P: TJ Bomb	USA USA		11 625	766	..
	Vought	A-7E Corsair-2	Fighter	P: TF AAM ASM Bomb Cann Rock	USA USA USA USA USA USA	 2	8 800	925	..
	Bell	Bell-206L	Hel				944	241	..
	Bell	Bell-209 AH-1S	Hel	P: TS ATM Cann Rock	Can USA USA USA		..	352	..
	Bell	Bell-209 AH-1T	Hel	P: TS Cann Rock	Can USA USA		3 635	..	..
	Bell	Bell-212	Hel	P: TS	Can		2 640	194	439
	Bell	Bell-214A	Hel	P: TS			..	241	481
	Bell	Bell-214C	Hel				..	..	..
	Bell	Bell-301	Hel	P: TS	USA		4 354	562	825
	Boeing	Boeing 707-320C	Transport	P: TF			62 872	966	..
	Boeing	Boeing 737-200C	Transport	P: TF			27 964	927	4 075
	Boeing	Boeing 747-131	Transport				..	..	..
	Boeing	Boeing 747-200F	Transport	P: TF			..	978	..
	Boeing	Boeing-737-100	Transport				27 310	1 010	..
	Lockheed	C-130H Hercules	Transport	P: TP			34 169	620	8 624

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	..	..	..	..	..	..	
1975	1977	1979	..	..	..	..	..	
..	..	1967	..	..	7	..	..	
..	1972	1975	74	..	100	..	6.0	
..	1963	1967	..	..	600	..	0.5	
..	..	..	18	..	3 000	..	6.3	
..	1972	1972	..	..	..	..	..	Version for Israel; remained in production in 1978
..	1970	1972	12	..	201	..	14.8	
1963	1968	1969	24	..	1 600	..	8.5	
..	..	1973	..	..	..	..	..	
1975	..	1976	..	..	2 200	..	1.5	For army
1975	..	1976	..	..	25	..	..	
..	1969	1970	..	..	700	..	1.5	
1970	1974	1974	..	..	150	..	..	Most of R&D paid by Iran
1970	1974	1974	..	..	38	..	..	
1973	1977	..	..	..	..	37.2	..	Developed to meet army/NASA requirement; R&D cost: estimate for 4-year period
..	..	1963	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	1969	..	..	350	..	..	
..	..	1972	..	..	..	..	..	
..	..	1967	..	..	..	..	..	
..	1964	1973	36	..	518	..	5.0	Total delivery of all versions C-130 since 1952: 998 to USAF, 433 to other air forces; total turnover: $5 200 mn, of which $4 200 mn for C-130 H; now defined as 'lethal'; needs congressional approval for export

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Cessna	Cessna T-37C	Trainer/COIN	P: TJ	USA		..	612	1 302
	Cessna	Cessna-172	Trainer				..	193	..
	Cessna	Cessna-180	Lightplane				765	269	1 334
	Cessna	Cessna-421C	Trainer	P: TJ	USA		..	..	..
	Cessna	Cessna-A150	Trainer	P: PI	USA		496	195	621
	Boeing-Vertol	CH-47C Chinook	Hel	P: TS	USA		9 428	257	2 267
	Boeing-Vertol	CH-47D Chinook	Hel				..	..	..
	Sikorsky	CH-53E	Hel	P: TS	USA		14 536	315	..
	Lockheed	CP-140 Aurora	ASW/Mar patrol	P: TP	USA		27 890	732	8 339
	Grumman	E-2C Hawkeye	AEW	P: TP	USA		17 090	602	2 583
	Boeing	E-3A Sentry	AEW	P: TF	USA		..	926	..
	Boeing	E-4B	AEW				..	958	..
	Grumman	EA-6B Prowler	Fighter	P: TJ	Can		14 588	774	1 769
	Grumman	F-14A Tomcat	Fighter/strike	P: TF	USA		17 010	2 937	..
	MDD	F-15A Eagle	Fighter/interc	P: TF AAM	USA USA		..	1 482	5 560
	MDD	F-15C Eagle	Fighter	P: TF	USA		..	..	..
	MDD	F-15D Eagle	Trainer	P: TF	USA		..	..	..
	GD	F-16A	Fighter/strike	P: TF	USA		6 377	2 448	3 705
	GD	F-16B	Fighter/strike	P: TF	USA		6 377	2 448	3 705
	MDD	F-18 Hornet	Fighter/strike				19 960	1 468	..
	MDD/Northrop	F-18L Cobra	Fighter/strike	AAM Cann	USA USA		..	1 468	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1954	..	..	..	..	1 300	..	..	
..	..	..	..	..	30 000	..	..	
..	..	1961	200	..	6 000	..	..	
..	1965	1967	..	..	1 500	..	0.3	
..	..	1970	..	..	..	..	..	
..	1967	1968	36	..	250	..	6.3	Total number planned: 1 000th to be produced in 1982; total number delivered: 745 to US Army, rest for export
..	..	1982	..	..	..	..	..	
1973	1974	1978	..	..	..	1.7	..	R&D cost paid by US Navy; first 18 funding: $88.8 mn; delivery in 1980
1976	1979	1980	..	..	..	..	..	Designation: derivative of P-3C and S-3A Viking specially developed for Canada
..	1971	1971	6	..	20	..	42.5	
1970	1972	1975	7	..	14	..	102.8	Designation: Boeing AWACS; NATO agreed in principle to procure 18 aircraft at $1 400 mn for planes, plus $450 mn for support and modification
1973	1976	1979	..	..	..	353.2	..	R&D cost: for RDE&T until 1981, plus $499.5 mn for procurement, plus $28.1 mn for support facilities to replace military Boeing-707
1966	1968	1971	12	..	..	139.0	23.0	First US aircraft built for ECM warfare; R&D cost: including purchase of first 8
..	1970	..	24	..	250	..	20.6	Price escalation from $19.7 mn in 1977 due to reduced production rate from 36 to 24/year; original price was $11 mn; FY 1980 budget includes $600 mn for 24 F-14s
1965	1972	1974	120	..	400	..	17.7	Unit price: current flyaway u.c. quoted by GAO
..	..	1980	..	..	..	..	..	
..	..	1980	..	..	..	..	..	
..	1975	1978	..	..	..	..	10.8	Flyaway u.c. 1978: $10.8 mn; $ 1900 mn received in May 1978 to launch production of first 352, including 192 for European co-production; planned production rate in 1981: 15/month in USA and 10/month in Europe
..	..	..	9	..	156	..	..	
1974	1978	1982	..	..	..	..	15.6	
1977	..	1982	..	..	..	..	16.0	Land-based version under development for Iran

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	MDD	F-4E Phantom	Fighter	P: TJ AAM ASM	USA USA USA		..	2 692	3 700
	MDD	F-4G Wildweasel	Fighter				13 757	2 692	3 184
	Northrop	F-5E Tiger-2	Fighter	P: TJ	USA		4 275	1 995	3 720
	Northrop	F-5F Tiger-2	Trainer	P: TJ AAM	USA USA	 2	4 275	1 897	3 710
	Grumman	Gulfstream-2	Transport	P:	USA		..	1 040	..
	Sikorsky	HH-53C	Hel	P: TS	USA		10 690	315	869
	Hughes	Hughes-300C	Hel				471	169	373
	Hughes	Hughes-500MD	Hel				..	..	..
	Bell	Jetranger-3	Hel	P: TS	USA		660	225	580
	Lockheed	Jetstar-2	Transport	P: TF	USA		10 967	1 064	5 132
	Lockheed	KC-130H	Transport				34 169	621	..
	Beech	King Air A-100	Transport	P: TP	USA		3 069	459	2 483
	Beech	King Air C-90	Trainer	P: TP	Can		2 576	407	2 327
	Beech	King Air E-90	Trainer	P: TP	Can		2 710	462	2 425
	Lockheed	L-400	Transport				23 971	463	5 649
	Swearingen	Merlin-3A	Lightplane	P: TP			3 356	323	4 602
	Swearingen	Merlin-4A	Lightplane	P: TP			3 719	499	3 371
	Swearingen	Metro-2	Transport	P: TP	USA		3 379	473	3 952
	Bell	OH-58C Kiowa	Hel				..	..	..
	Rockwell	OV-10A Bronco	Trainer/COIN	P: TP	USA		3 161	452	2 298
	Lockheed	P-3C Update-2	Fighter/ASW	P: TP AShM	USA USA		27 890	761	..
	Lockheed	P-3C Update-3	Fighter/ASW	P: TP AShM	USA USA		27 890	761	..
	Cessna	R-172K Hawk XP	Lightplane				703	246	1 066

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	1967	..	72	..	1 300	..	4.1	Produced in 13 basic versions; production to end Oct 1978; licence production in Japan to continue until 1980
1976	1976	..	..	..	77	..	..	Modification of 116 F-4E during 1976–79; for suppression of hostile weapon radar-guidance systems
1970	1972	1973	158	..	4 000	..	7.5	U.c.: average fly-away 1978; Northrop hopes to extend sales further 10 years to meet market for up to 2 000 aircraft
1970	1972	1973	25	..	..	..	..	
..	..	1966	20	..	250	..	..	
1962	..	1968	..	..	..	..	..	
..	1969	1969	70	..	600	..	..	
..	1977	1977	180	..	..	..	..	
..	..	1977	300	..	6 000	..	..	Designation: current version of Bell-206; total number produced: all versions by 1978
1972	..	1975	..	..	..	..	..	
..	..	1974	..	..	..	..	..	
..	..	1969	..	..	284	..	0.5	
..	..	1970	..	..	1 259	..	0.7	Total number produced: C-90, A-100, Super King Air, including 425 aircraft exported to 50 countries
1972	..	1976	..	..	38	..	..	Designation: military version of C-90 for US Navy off-shelf trainer
..	1977	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	33	..	..	Designation: Merlin-4A version; sold to police forces of Chile and Oman
1976	1976	..	..	..	6 000	..	0.2	
1961	..	1965	..	..	400	..	2.4	Designation OV-10F: for Indonesia; design won 1964 competition for COIN aircraft
1976	1976	1977	30	..	500	..	..	Added IR detection system; first introduced in Aug 1977
1977	1979	1980	..	..	..	7.0	..	Version with new ASW electronics; funding of prototype production: $7 mn for completion Mar 1980; delivery in Sep 1980; similar to CP-140 for Canada
..	.	1976	..	..	300	..	..	Model R172-E production completed; XP version licence produced in France

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Country	Number	Wt	Speed	Range
	MDD	RF-4E Phantom	Recce	P: TJ	USA		..	2 692	3 700
	Northrop	RF-5E Tiger-2	Recce	P: TJ	USA		..	..	..
	Lockheed	S-3A Viking	Fighter/ASW	P: TF Bomb Mine Rock TT	USA USA USA USA USA		12 088	686	3 705
	Sikorsky	S-61A-4 Nuri	Hel	P: TS	USA		4 428	219	1 005
	Sikorsky	S-69	Hel	P: TJ	Can		..	555	..
	Sikorsky	S-72	Hel	P: TS	USA		..	555	..
	Sikorsky	S-76	Hel	P: TS	USA		2 241	269	..
	Kaman	SH-2F Seasprite	Hel				3 193	241	679
	Beech	Super King Air	Transport	P: TP	Can		3 318	591	3 338
	Beech	T-34C-1	Trainer	P: TP	Can		1 193	397	185
	MDD	TF-15A Eagle	Trainer				..	..	..
	Lockheed	TR-1	Recce	P:	USA		..	690	..
	Sikorsky	UH-60A LAMPS-3	Hel	P: TS MG	USA USA		4 944	272	556
	Lockheed	US-3A Viking	Transport	P: TF	USA		10 954	686	6 075
	Rockwell	XFV-12A	Fighter	P: TF AAM ASM	Can USA USA		..	2 448	..
	Hughes	YAH-64	Hel	P: TS Cann ATM Rock	USA USA USA USA		4 309	289	578
	Boeing	YC-14 AMST	Transport	P: TF	USA		53 279	723	5 133
	Boeing-Vertol	YUH-61A LAMPS	Hel	P: TS	USA		..	265	..
	Bell Aerospace	..	LVA				..	112	88
	Allison Div.	M-109-A1	SPH	P: D MG	USA USA	 1	26	56	390
	FMC	M-113-A1	ICV	P: D	USA		13	61	490

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	1958	..	..	..	..	..	..	
1978	1979	1981	..	..	..	..	..	R&D programme launched in 1978
1969	1972	1973	..	..	187	494.0	..	
1957	1959	1961	..	..	..	..	..	
1972	1973	..	..	..	..	..	..	Testing programme continues; developed to meet army requirement
1974	1976	..	..	..	..	..	..	Developed to meet NASA/army requirement; expected service life: 12 years
1975	1977	1978	8	..	8	..	..	
..	1971	1973	15	..	100	..	..	For DD-963, FFG-7 class ships
1970	1972	1973	..	..	457	..	..	Total number produced: for USAF and Army; maritime patrol version announced in 1977; total cost for 90: $61 mn
1973	1973	1977	..	..	80	..	0.8	Redesign of T-34A; developed for US Navy; total of 162 sold by 1978
1965	1973	1973	..	..	..	..	..	
1978	..	1979	..	..	..	10.2	..	Designation: U-2 development in $10.2 mn-programme; FY 1979 funding
1972	1974	1978	9	100	9	..	..	Design won UTTAS (Utility Tactical Transport Model S-70) competition in 1976; developed for army; total requirement: 1 100 at $2 500 mn
1975	1976	..	..	..	..	3.0	..	
1973	1977	..	..	..	..	..	..	Design begun to meet US Navy requirement
1973	1975	1980	..	..	..	70.3	1.6	Hughes won competition with Bell in 1976 to meet army requirement; u.c.: target fly-away; funding: $317.7 mn received for 4-year engineering development
1972	1976	..	..	..	..	105.9	..	Design begun to meet USAF requirement; development delayed due to cost escalation
1972	1978	..	..	..	..	..	14.5	
1975	..	..	..	..	..	..	..	
1956	1959	1961	..	..	4 000	..	..	
1968	1970	1975	..	..	..	..	..	By 1984 some 4 000 M-113 with petrol P will be phased out; FY 1978 requirement: 960 at $72.8 mn

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Chrysler Corp.	M-60-A3	MBT				50	..	..
	Chrysler Corp.	M-728	AEV	Gun MG	USA USA		..	..	..
	..	..	LT				17	..	..
	Cadillac Gage	V-150	APC				9	89	960
	Chrysler Corp.	XM-1	MBT				58	48	..
	FMC	XM-723	MICV	P: D Cann MG	USA USA USA	 1 1	..	72	483
	FMC	XM-765	ICV	P: D	USA		13	62	490
	Lockheed	XM-800	Recce SC	P: D Cann MG	USA USA USA		7	105	725
	FMC	XR-311	Recce SC	P: P	USA		3	129	480
	GD	AGM-109 TALCM	CM	P: S	USA		..	..	2 500
	Texas Instruments	AGM-45A Shrike	ARM	P: S	USA		66	2 448	40
	Martin Marietta	AGM-62-2	ASM				907	..	..
	Hughes	AGM-65B	ASM	P: S	USA		59	..	22
	Hughes	AGM-65C	ASM	P: S	USA		59	1	53
	Hughes	AGM-65D	ASM	P: S	USA		59	1	87
	GD	AGM-78D	ARM	P: S	USA		..	2 448	30
	MDD	AGM-84A Harpoon	ASM	P: TJ	USA		238	1 040	145
	Boeing	AGM-86B ALCM-B	CM	P: TF	USA		..	..	2 500
	Texas Instruments	AGM-88 HARM	ARM	P: S	USA		..	..	18
	Hughes	AIM-54A Phoenix	AAM	P: S	USA		60	4 038	165
	Hughes	AIM-54C Phoenix	AAM				..	..	..
	GD/Raytheon	AIM-7F Sparrow	AAM	P: S	USA		30	..	44

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1975	480	..	1 514	..	..	FY 1978 requirement: 960; production rate to increase from 40 to 103/month by 1979/80
1963	1965	1968	..	..	106	..	..	Based on modification of M-60-A1 tank chassis
..	..	1985	..	..	..	..	..	Under development to meet army/navy requirement for air-portable tank
..	1971	..	..	..	3 500	..	..	Total number produced: including V-100 and V-200 versions
..	1976	1979	..	3 325	..	..	..	At final development stage; to be delivered in 1980; planned production rates: 1979—10/month, 1980—30/month; total requirement: 3 325; arms: 105-mm US gun, later to get either FRG or UK 120-mm
..	1972	..	..	..	..	..	..	Amphibious vehicle; production contract 1978; delivery to start early 1980
1967	1970	..	..	..	..	..	..	Several versions under development
1971	1975	..	..	..	..	..	..	Wheeled version at test stage
1969	1970	..	..	..	..	..	..	Tests completed; in service with Israeli Army; produced on request
..	1979	..	..	..	..	..	0.8	
1961	..	1963	..	..	25 000	..	0.5	
1968	1973	1974	..	..	..	..	..	
..	..	1976	..	..	6 350	..	..	
1972	1973	1977	..	..	100	56.2	..	
1976	..	1981	..	..	..	117.4	..	
1977	..	..	..	..	..	..	..	
1968	1972	1975	..	..	2 000	..	0.5	
1978	..	..	..	..	..	..	0.8	
1972	1976	1980	..	..	..	..	..	
1962	1966	1970	..	..	2 206	416.0	..	
1978	..	..	..	..	..	..	..	For F-14A in USA and Iran to meet airborne threats through 1990s; improved version of AIM-54A
1968	1972	1977	..	..	1 320	128.5	0.1	Total number produced: versions C/D/E: for F-4E, F-14A and F-15A

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Raytheon	AIM-9L	AAM	P: S	USA		..	..	3
	..	AMRAAM	Adv AAM				90	..	..
	..	ASMD	ACM/ShAM/ ShShM				..	..	..
	Hughes	BGM-71A TOW	ATM	P: S	USA		3	1 000	4
	Hughes	Brazo	ARM				..	..	..
	Ford	Chaparral	Landmob SAM	P: S	USA		50	2	8
	Koll/MDD/ Raytheon	FGM-77A Dragon	Landmob/port ATM	P: S	USA		2	360	1
	GD	..	CM				..	856	2 400
	Rockwell Int.	Hellfire	ASM	P:	USA		9	..	6
	Boeing	LGM-30G	ICBM	P: S	USA		..	..	..
	LTV	MGM-52C Lance	SSM	P: SL	USA		454	3	120
	Raytheon	MIM-23B Hawk	Landmob SAM	P: S	USA		59	2	41
	..	MX	ICBM				..	..	..
	Raytheon	Patriot	Landmob SAM	P: S	USA		..	..	..
	Martin Marietta	Pershing-2	SSM	P: S	USA		..	..	1 288
	MDD	RGM-84A Harpoon	ShShM	P: S	USA		232	..	90
	GD	RIM-66A/SM-1	ShAM/ShShM				..	2	19

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1972	1975	1977	..	2 900	..	52.0	..	Designation: Super Sidewinder; third generation AAM; total requirement for USA: 1 000 for AF, 420 for Navy
1976	..	..	..	..	..	81.6	..	R&D cost: for RDT&E up to prototype completion; FY 1978 request: $23.6 mn
..	1979	..	..	..	..	..	..	US Navy/FRG government joint evaluation; US Navy funding of R&D; advanced development to be completed in 1978
1968	1968	1969	..	..	217 000	156.0	..	For cross-country vehicles and hel
..	1974	..	..	..	..	4.0	..	Joint USAF/Navy project; R&D funding FY 1978: $4 mn
1970	..	1976	..	..	3 082	..	..	To stay in service until replaced by licence-produced Roland-2; development of Sidewinder-1C; 4-round launcher on tracked M-730 vehicle; FY 1977 funding for production of 2 000: $59.1 mn and $4.1 mn for continued RDT&E
1966	1971	1972	..	..	103 720	75.0	..	Shoulder-launched; designed to replace 90-mm recoilless rifle; R&D costs 1966–72: $75 mn
1978	..	..	..	..	..	..	..	Designation: Ground-launched Cruise Missile; derivative of land-attack version of BGM-109 Tomahawk; anti-ship variant under study
1971	1971	1981	..	..	..	..	..	
1966	1968	1970	..	..	..	..	..	
1962	1965	1971	..	..	2 200	..	0.4	New army requirement: cluster-bomb warhead; system u.c.: $3.7 mn
1964	1971	1972	..	..	11 300	155.0	0.1	FY 1978 funding: $163.4 mn; Dragon vehicle
..	1984	..	..	..	..	497.0	..	Continued research programme; to replace Minuteman from mid-1980s; R&D cost: $497 mn in FY 1978; USAF estimate of programme cost: $28 000 mn
1965	1970	1981	..	..	..	1 728.0	..	R&D costs: until FY 1980; development to meet SAM-D requirement specified in 1965; replacing 2 earlier projects: Hawk and Nike Hercules; warhead: N/HE
1978	..	1981	..	..	..	..	..	
1971	1972	1976	315	..	..	66.0	0.6	First delivered in 1977; designed for all US Navy surface ships and for S-3A Viking and P3C Orion aircraft
1964	1965	1966	480	..	..	..	..	Developed as medium-range ShShM to replace Terrier/Tartar; SM-1 version exists in both ranges; FY 1978 funding: $102.1 mn for 408

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun-try	Num-ber	Technical data Wt	Speed	Range
	GD	RIM-66C/SM-2	ShAM/ShShM	P: S	USA		..	3 427	48
	GD	RIM-67A/SM-1	ShAM/ShShM				..	2	57
	GD	RIM-67C/SM-2	ShAM/ShShM	P: S	USA		..	3 427	96
	Raytheon	Seasparrow	ShAM/ShShM				..	..	..
	GD	Stinger	Port SAM				..	..	..
	GD	Tomahawk	SuShM	P	USA		454	856	3 700
	Lockheed	Trident-1	SLBM				..	..	11 000
	Lockheed	UGM-93A	SLBM	P: S	USA		..	..	7 800
	National Steel	AD-41 class	Destroyer tender	P: ST Cann ShAM	USA USA USA	 5 1	20 500	18	..
	..	..	Aircr carrier	P	USA		60 000	..	..
	Avondale	AO-177 Class	Tanker	P: GT Cann Hel Rock	 USA USA	 2	25 000	20	..
	..	..	Corvette	P ShSh Cann Mort TT	USA USA Italy USA USA	 8 1 3 6	720	30	..
	..	CSGN type	Nucl cruiser	P: N Aircr CIWS CM Hel ShSh ShAM ShSu TT	USA USA USA USA USA USA USA USA	 2 2 16 6	17 210	30	..
	Litton/Bath	DDG-47 type	Destroyer	P: GT Cann ShAM ShSh ShSu CIWS TT	USA USA USA USA USA USA USA	 4 4 8 8 2	9 055	30	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	1978	..	..	..	..	..	0.2	
1964	1965	1966	..	..	..	..	..	Developed as extended-range ShShM to replace Terrier/Tartar; FY 1978 funding: $47.7 mn for 40
1976	1978	1978	..	..	..	..	1.3	
1968	1972	1973	..	..	1 400	..	..	Joint memo signed in 1968 by Belgium, Denmark, Italy, Norway and USA for NATO Seasparrow programme; Netherlands joined in 1970, FRG in 1976; USA to buy 75 systems and NATO to buy 29
..	1973	1978	258	4 650	..	..	..	Stinger-2 version also under development as competitor; FY 1978 funding: $34 mn for 258 missiles; FY 1979 funding: $124.4 mn
1974	1976	..	..	..	..	..	..	
..	..	1978	..	..	..	..	15.6	
1971	1977	..	..	..	..	2 926.0	14.0	
1977	..	1980	..	5	..	289.1	..	R&D cost for 2 ships 1980–81: $260.4 mn; weight: full-load; arms: 1 × Seasparrow; can serve 6 destroyers at same time
1979	..	..	..	..	..	..	..	New class: design ordered by Pres. Carter; rejected construction of fourth 90 000-t carrier
1977	..	1980	..	3	..	..	..	Weight: full-load; total number planned: 3; approved FY 1976–77; 18 planned through FY 1983
1976	..	..	..	..	..	..	..	
1979	..	..	..	..	2	..	..	First to be laid down FY 1979, second FY 1982; arms: SM-2 Standard/ ASROC, 16 × Harpoon, Vulcan-Phalanx AA-system; can carry Tomahawk cruise missile
1978	..	1982	..	16	..	938.0	..	Total number planned: to complete in 1990; weight: full-load; Aegis-Standard fire-control system

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Lockheed SB	Emory S Land	Sub tender	P: ST Cann	USA	 6	12 770	20	..
	Sandaire	Firefish-3	PB				6	..	..
	Newport/Gendyn	Los Angeles class	Nucl sub	P: N SuSu SuSh TT	USA USA USA USA	 4	6 000	40	..
	..	..	MCM	P: D			..	..	..
	..	Modif Virginia	Nucl cruiser	P: N Cann ShAM ShSu TT	USA USA USA USA USA	 6 4 4 6	12 000	30	..
	Peterson	MSC-322 class	Coast minesweeper				..	..	..
	Newport News	Nimitz class	Nucl aircr carrier	P: N Cann ShAM	USA USA USA	 5 3	81 600	30	..
	Bath Iron/Todd	Oliver H Perry class	Frigate	P: GT Cann CIWS Hel ShAM ShSh TT	USA Italy USA USA USA USA USA	 1 1 2 1 1 6	3 550	28	4 500
	Aerojet/Bell	SES-100A/B	Air cushion FPB	P: GT	USA		100	80	..
	Aerojet/Bell	SES-3000	Air cushion FPB	Hel ShSh TT	USA USA USA	2	3 000	80	..
	Ingalls	Spruance class	Destroyer	P: GT Cann CIWS Hel ShAM ShSu ECM	USA USA USA USA USA USA USA	 2 2 1 1	8 010	30	6 000
	..	Spruance Impr	Destroyer	P: GT ShSh ShSu ShAM Cann TT	USA USA USA USA	 8 8 8 2 6	9 000	30	..
	..	Swath project	PB				140	..	..

Year design begun	Year of first proto- type test	Year in pro- duction	Current annual produc- tion rate	Total number planned	Total number pro- duced	Develop- ment cost	Unit cost	Comments
1976	1977	1979	..	3	..	260.9	..	Can support 12 submarines at a time; arms: Seasparrow ShAM; last to be completed in 1981
..	..	..	..	..	..	..	..	
1972	1974	1976	4	31	..	330.0	278.5	R&D cost FY 1977: escalated from $221.25 mn in FY 1976; u.c.: at 1978 prices; total number planned: approved through FY 1978; total requirement: 40
1980	..	..	..	5	..	110.0	..	R&D cost estimate per ship: $100–110 mn
1978	..	1984	..	4	..	1 082.0	..	
1975	..	1978	..	..	..	..	..	
1968	1972	1975	..	3	..	2 000.0	..	R&D cost for last 2 ships estimated at $4 000 mn; production delayed; may be replaced by new class of 60 000-t carriers
1975	1976	1977	..	26	..	191.0	170.0	Designation: FFG-7; total number planned: including 2 for Australia; cost development: $60 mn u.c. in 1972, $147.4 mn in 1977 for 8 ships, $146.5 mn in 1978 for 9 ships
..	1977	..	..	..	..	..	..	Two prototypes being used for experiments
1978	1980	..	..	1	..	..	..	Second phase of experiments; SES trials to begin in 1980· Y 1979 funding
1972	1973	1975	8	30	..	..	256.0	Original u.c.: $81 mn; 1973 u.c. for Iran: $116 mn (in 1975, $238 mn); arms: Seasparrow ShAM, ASROC, Vulcan-Phalanx AA-system
1978	..	1982	..	1	..	310.0	..	Only ship of class; approved in FY 1978
..	1978	..	..	1	..	..	..	One experimental SSP being tested

				Standard equipment			Technical data		
Region code/ Country	Manufacturer	Weapon designation	Weapon description	Type	Coun- try	Num- ber	Wt	Speed	Range
	Ingalls	Tarawa class	FPB	P: GT Airc Cann ShAM	USA USA USA USA	 30 9 2	39 300	24	..
	Peterson	..	Training				..	..	..
	General Dynamics	Trident	NBMS	P: N SLBM TT	USA USA USA	 24 4	16 600	25	..
	..	..	FPB	ShSh Cann Mort	USA Italy USA	4 1 3	320	38	..
	Newport News	Virginia class	Nucl cruiser	P: N Cann Hel ShAM ShSh ShSu TT	USA USA USA USA USA USA USA	 2 1 2 2 6	11 260	30	..
2 USSR	Mil	A-10	Hel	P: TS	USSR		..	341	..
	Antonov	An-24 Coke	Transport	P: TP	USSR		14 060	450	3 000
	Antonov	An-26 Curl	Transport	P: TP	USSR		1 520	425	900
	Antonov	An-32 Cline	Transport	P: TP	USSR		..	510	800
	Antonov	An-40	Transport	P: TF	USSR		..	..	..
	Antonov	An-72	Transport	P: TF	USSR		..	..	..
	Beriev	Be-32	Transport				..	..	..
	Ilyushin	Il-38 May	ASW/Mar patrol	P: TP	USSR		..	645	7 250
	Ilyushin	Il-76 Candid	Transport	P: TF	USSR		..	850	6 700
	Ilyushin	Il-86 Camber	Transport	P: TF	USSR		..	950	2 350
	Kamov	Ka-25 Hormone	Hel	P: TS ASM	USSR USSR	 2	..	220	650
	Kamov	Ka-26	Hel	P	USSR		3 000	..	..
	Mil	Mi-14 Haze	Hel				..	..	..
	Mil	Mi-24 Hind-C	Hel	P: TS	USSR		..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1971	1973	1976	1	5	..	1 145.0	230.0	Weight: full-load; R&D cost estimate for 5 ships
..	..	1979	..	..	3	..	..	New class for completion Jan–May 1979; no data available
1976	1977	1979	..	..	5	18 000	..	R&D cost for first 10; total number planned: 8 proposed for FY 1978–FY 1982; arms: 24 Trident-1 missiles
1976	..	..	..	..	..	..	..	
1972	1974	1976	1	..	4	..	368.0	Weight: full-load; fifth ship cancelled, replaced by Virginia Modif.

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	1975	..	..	..	..	..	..	Believed to be development of Mi-24
1958	1960	..	..	..	..	..	..	
..	..	1968	..	..	(1 000)	..	..	
..	..	1977	..	..	(1 000)	..	..	For paratroop/cargo transport in mountain or tropical areas; offered for export
1977	..	..	..	..	..	..	..	To replace An-22
..	1977	..	..	..	..	..	..	To replace An-26; capacity: 55 troops/40 paratroops/6 500 kg
..	1976	..	..	..	..	..	..	USSR claimed height record; not known if will be produced
..	1967	1970	10	..	(85)	..	..	Il-18 derivative; production rate: 10–12/year for navy
..	1971	1974	..	..	..	..	..	Replaces An-10/12; civilian version Il-76T; aerial tanker/AEW versions projected to replace Tu-126 Moss
1971	1976	1977	..	..	6	..	..	First 6 to be delivered in 1979; requirement for long-range version to fly 1980, with UK/US P
..	1961	1967	..	..	300	..	..	Total number produced, versions A and B: 250 in Soviet Navy, rest for export to India and Yugoslavia
1976	..	..	..	..	..	..	..	
..	..	1977	..	..	..	..	..	Designation unconfirmed: new type in service with ASW units; first reported in 1977
..	..	1975	..	..	(400)	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	Mil	Mi-24 Hind-D	Hel	P: TS ATM MG Rock Bomb	USSR USSR USSR USSR USSR	 4 1 128	..	..	..
	Mil	Mi-8 Hip	Hel	P: TS	USSR		6 816	260	1 200
	Mikoyan	MiG-21Bis	Fighter	P: TJ	USSR		..	..	..
	Mikoyan	MiG-23MB	Fighter/close support	P: TJ	USSR		..	1 836	..
	Mikoyan	MiG-23MS	Fighter/interc	P: TJ	USSR		..	2 815	..
	Mikoyan	MiG-23S	Fighter	AAM	USSR	2	..	..	..
	Mikoyan	MiG-23U	Trainer	P: TJ	USSR		..	2 815	..
	Mikoyan	MiG-25M	Fighter/interc	AAM Cann	USSR USSR		..	3 672	..
	Mikoyan	MiG-25R	Recce	P: TJ	USSR		..	3 916	..
	Mikoyan	MiG-25U	Trainer	P: TJ	USSR		20 000	3 916	1 300
	Mikoyan	MiG-27	Fighter/strike	P: TJ Cann ASM	USSR		15 500	1 836	..
	Mikoyan	(MiG-29)	Fighter				..	..	..
	Sukhoi	Su-15 Flagon-F	Fighter/interc	P: TJ AAM	USSR USSR	 2	..	3 060	725
	Sukhoi	Su-19 Fencer	Fighter/ground attack	P: TJ Cann ASM Bomb	USSR USSR USSR USSR		16 000	2 448	6 000
	Sukhoi	Su-20 Fitter-C	Fighter/ground attack				..	..	..
	Tupolev	Tu-16B Badger-B	Bomber	P: TJ	USSR		33 000	945	6 400
	Tupolev	Tu-26 Backfire	Bomber	P: TF	USSR		..	3 060	9 600
	Yakovlev	Yak-36 Forger	Recce	Cann Rock	USSR USSR		..	1 836	..
	Yakovlev	Yak-40 Codling	Transport	P: TF	USSR		9 400	550	2 000

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1976	..	..	(400)	..	..	
..	1960	1963	100	..	(1 700)	..	..	Produced in 4 versions
..	..	1976	..	..	(3 600)	..	..	Designation: versions Fishbed L/N, third generation; licence-produced in India
..	1970	1975	..	..	(150)	..	2.8	Designation: MiG-27 export version; u.c.: price offer to India 1978
1962	1967	1971	..	..	(150)	..	..	Designation: MiG-23S Flogger-E; lower-technology derivative exported to Middle East; less powerful P
1961	..	1971	500	..	(800)	..	..	Designation: Flogger-B for USSR, Flogger-E export version; production rate: all versions of MiG-23/27
1962	1967	1971	..	..	(800)	..	..	
..	..	1975	..	..	(400)	..	..	
..	..	1969	..	..	..	..	..	
..	1964	..	..	..	(400)	..	..	
..	1970	1973	..	..	(1 000)	..	..	Production year: first seen in GDR; u.c.: price offer to India 1978; total number produced: all versions of MiG-23/27
1977	..	..	..	..	..	..	..	Designation unconfirmed; according to NATO sources, new design for anti-cruise-missile defence
..	..	1974	80	..	(900)	..	..	Current production model; replaces Flagon-E
1968	1971	1974	70	..	(200)	..	..	First Soviet ground attack design
..	1965	1970	..	..	..	..	..	Designation Su-22 export version
..	..	1954	..	..	..	..	..	
..	1969	1973	36	..	(100)	..	..	Total number produced/planned: according to US intelligence; key aircraft in SALT
..	1974	1976	..	..	(36)	..	..	New design; according to US sources, developed for use on aircraft carrier Kiev class; versions A/B
..	1966	1967	100	..	(1 000)	..	..	Small number in Soviet AF, rest for civilian use; civilian version to be licence-produced in USA

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	Soviet State Arsenal	BMP-40	APC	ATM	USSR	4	..	..	..
	Soviet State Arsenal	T-64	MBT				38	80	500
	..	T-80	MBT				..	..	..
	..	ZSU-23-4 Shilka	SPG	Gun	USSR	4	14	44	260
	Soviet State Arsenal	ZSU-57-2	SPH				28	48	400
	..	AA-2 Adv Atoll	AAM				..	..	..
	..	AA-2 Atoll	AAM	P: S			..	..	3
	..	AA-3 Anab	AAM	P: S			..	..	16
	..	AA-5 Ash	AAM				..	..	30
	..	AA-6 Acrid	AAM	P: S			100	..	50
	..	AA-7 Apex	AAM				40	..	35
	..	AA-8 Aphid	AAM				(9)	..	(10)
	..	AS-4 Kitchen	ASM	P: L			..	..	800
	..	AS-5 Kelt	ASM				..	..	180
	..	AS-6 Kingfish	ASM				1 000	..	220
	..	AS-7 Kerry	ASM	P: S	USSR		..	..	..
	..	AT-3 Sagger	ATM	P: S	USSR		11	..	3
	..	AT-4 Fagot	ATM				..	..	2
	..	(FROG-9)	Landmob SAM				..	..	..
	..	SA-10	ACM/ShAM				..	..	50
	..	SA-2 Improved	Fixed SAM				..	..	..
	..	SA-3 Goa	Landmob SAM/ ShAM	P: S	USSR		..	..	30
	..	SA-4 Ganef	Landmob SAM	P: S	USSR		..	..	70
	..	SA-6 Gainful	Landmob SAM	P: S	USSR		80	..	60
	..	SA-7 Grail	Landmob/port SAM	P: S			1	..	3

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	..	..	..	..	..	..	
..	..	1974	..	..	..	..	..	
..	1978	1981	..	..	..	..	..	
..	..	1965	..	..	..	..	..	
.	..	1958	..	..	..	..	..	
.	..	..	..	..	..	..	..	For MiG-21Bis
	..	..	..	..	..	..	..	Soviet designation: K-13; for MiG-21/23
..	..	1960	..	..	(10 000)	..	..	For Su-11
..	..	1965	..	..	(5 000)	..	..	
..	..	1973	..	..	..	..	..	New generation; first seen 1975; may replace AA-5 for MiG-25; IR version also in production
..	..	1974	..	..	..	..	..	
..	..	1976	..	..	..	..	..	Data unconfirmed; may be Atoll replacement for MiG-23 in radar- and IR-version
..	..	..	..	..	..	..	..	For Tu-22 and Tu-26 Backfire-B; warhead: N/HE
..	..	..	..	..	..	..	..	For Tu-16 Badger-B
..	..	1975	..	..	..	..	..	For Tu-26 Backfire and Tu-16; entered service in 1976
..	..	..	..	..	..	..	..	For Su-7B
..	..	1964	..	..	..	..	..	
..	..	1975	..	..	..	..	..	Second generation for BTR-40 vehicles
..	..	..	..	..	..	..	..	Designation unconfirmed
..	..	1978	..	..	..	..	..	According to US DOD; new project under development in late 1980s
..	..	1967	..	..	..	..	..	
..	..	1960	..	..	..	..	..	Launched from mobile ramp or tracked vehicle; shipborne version in use by Soviet Navy
..	..	1964	..	..	..	..	..	First shown in 1964; in temporary use in Egypt but withdrawn before 1973; first exported to GDR (1977); tracked launcher vehicle with 2 missiles
..	1967	1967	..	..	..	..	..	Launched from tracked vehicle
..	..	1966	..	..	..	..	..	Expected service life of 10 years; shoulder launched from jeep with 4 container-launchers

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	..	SA-8 Gecko	SAM				..	..	16
	..	SA-9 Gaskin	Landmob SAM	P: S	USSR		..	..	8
	..	Scaleboard	Landmob SSM				..	..	800
	..	SCUD-B	Landmob SSM	P: L	USSR		..	..	270
	..	SCUD-C	Landmob SSM				..	..	450
	..	SS-18 Mod-1	ICBM	P: L	USSR		..	..	10 500
	..	SS-18 Mod-2	ICBM	P: L	USSR		..	..	9 250
	..	SS-18 Mod-3	ICBM	P: L	USSR		..	..	12 000
	..	SS-20	IRBM				..	..	4 800
	..	SSN-11	ShShM	P: S	USSR		..	..	40
	..	SSN-18	SLBM	P: L	USSR		..	..	9 500
	..	SSN-2 Styx	ShShM	P: S	USSR		..	1 101	40
	..	SSN-3 Shaddock	ShShM				..	..	550
	..	SSN-9	ShShM	P: S	USSR		..	..	275
	Leningrad	Aist class	Hovercraft				..	..	..
	Sudomekh	Alfa class	Nucl sub	P: N TT	USSR	 6	2 500	28	..
	..	Amur class	Depot	P: D	USSR		6 400	18	..
	Gorky	Charlie-2 class	NCMS	P: N CM ShSu	USSR USSR USSR	 8	4 500	28	..
	Severodvinsk	Delta-2 class	NBMS	P: N SLBM TT	USSR USSR USSR	 16 6	9 000	25	..
	Severodvinsk	Delta-3 class	NBMS	P: N SLBM TT	USSR USSR USSR	 16 6	9 000	25	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1975	..	..	..	..	..	Launched from specially-built vehicle with twin launcher and 8 reload missiles
..	..	1974	..	..	..	..	..	Launched from BRDM-2 vehicle with 4 container-launchers; in service in Soviet and WTO forces
..	..	1965	..	..	..	..	..	Derivative of SCUD-B on MAZ-543 transport vehicle
..	..	1960	..	..	..	..	..	Launched from MAZ-543 vehicle with 1 missile; warhead HE/N; exported to WTO and Middle East with HE warhead
..	1977	..	..	..	..	..	..	New version: replacement being developed
..	..	1973	..	..	..	..	..	
..	..	1975	..	..	..	..	..	
..	1976	1976	..	..	..	..	..	
..	..	1977	..	..	..	..	..	According to NATO intelligence sources, less than 20 deployed in East, and total of 300–400 to become deployed in Western USSR
..	..	1968	..	..	(248)	..	..	Reported as advanced Styx in new type of container-launchers; for Osa-2, Kildin and Kashin ships
..	1976	1977	..	..	..	..	..	
..	..	1959	..	..	..	..	..	First ShShM tested in 1967 war in Middle East and in India 1971
..	..	..	..	..	..	..	..	For Kynda and Kresta class, and on E2, J and W class submarines; reported deployment in Soviet Navy: 48 missiles on surface ships and 318 on submarines
..	..	1969	..	..	..	..	..	Standard arms for Nanuchka class except to India (SSN-11)
..	..	1977	..	..	5	..	..	In series production for Naval Infantry
..	..	1970	..	..	2	..	..	Long construction time indicates prototype of new class
..	..	1969	2	..	14	..	..	Weight: full-load
..	..	1973	..	..	3	..	..	
..	..	1973	(3)	..	8	..	..	Production rate: half of 12 submarines produced per year are Delta-2/3 class
..	..	1975	(3)	..	9	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun- try	Num- ber	Technical data Wt	Speed	Range
	..	..	Fleet repl				30 000	..	..
	Leningrad	Foxtrot class	Sub	P: D	USSR		21 000	17	..
	..	Grisha class	Corvette	P: GT	USSR		900	30	..
				Cann	USSR	4			
				ShAM	USSR	2			
				TT	USSR	4			
	Nikolayev South	Kara class	Cruiser	P: GT	USSR		8 200	34	..
				Cann	USSR	8			
				Hel	USSR	1			
				ShAM	USSR	8			
				ShSh	USSR	8			
				TT	USSR	10			
	Nikolayev South	Kiev class	Aircr carrier	P: ST	USSR		35 000	30	13 000
				Cann	USSR	12			
				Hel	USSR	15			
				Aircr	USSR	10			
				ShAM	USSR	4			
				ShSh	USSR	8			
				RL	USSR	2			
				TT	USSR	10			
	..	Koni class	Frigate	P: GT			2 500	..	..
				Cann	USSR	6			
	Zhdanov Yard	Kresta-2 class	Cruiser	P: ST	USSR		6 000	35	5 500
				Rock	USSR	4			
				Cann	USSR	8			
				ShAM	USSR	4			
				ShSu	USSR	8			
	Kaliningrad	Krivak-1 class	Destroyer	P: GT	USSR		3 300	32	..
				Cann	USSR	4			
				ShAM	USSR	4			
				ShSu	USSR	4			
				TT	USSR	8			
	Leningrad	Krivak-2 class	Destroyer	P: GT	USSR		3 300	32	..
				Cann	USSR	2			
				ShAM	USSR	4			
				ShSu	USSR	4			
				TT	USSR	8			
	Leningrad	Nanuchka class	Corvette	P: D	USSR		800	32	..
				Cann	USSR	2			
				ShAM	USSR	2			
				ShSh	USSR	6			
	..	Natya class	Ocean minesweeper	P: D	USSR		650	18	..
				Cann	USSR	8			
	Leningrad	..	Nucl cruiser	P: N	USSR		20 000	..	..
				ASW	USSR				
				Cann	USSR				
				Hel	USSR				
				Rock	USSR				
				ShAM	USSR				
				ShSh	USSR				
	..	Osa-2 class	FPB	P: D	USSR		165	32	800
				Cann	USSR	4			
				ShSh	USSR	4			

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	..	..	..	1	..	..	..	For merchant service but can serve as aircraft-carrier support ship
..	..	1976	1	6	..	..	..	Production reopened for Libya
1969	..	1972	4	30	..	..	..	Versions 1/2/3 differ in armaments
1969	1971	1973	1	8	..	..	..	Weight: full-load; production year: first seen
1971	1972	1976	1	..	3	..	..	Weight: full-load
..	..	1977	..	..	1	..	..	New class first reported in 1977; to replace Riga class
..	..	1968	2	..	12	..	..	Last 2 of class completed 1978; to be replaced by Kara class
..	..	1971	3	..	15	..	..	
..	..	1971	1	..	4	..	..	
1969	..	..	3	..	23	..	..	Total number produced: 17 for Soviet Navy and 6 for India; Indian ships differ in armaments
..	..	..	3	..	24	..	..	Weight: full-load
..	1979	1980	..	..	..	..	..	New nuclear-powered surface ship reported for deployment in 1980–81; designation unknown
..	..	1976	3	..	24	..	..	

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	..	Sarancha class	Hydrofoil FPB	P: GT Cann ShAM ShSh	 USSR USSR USSR	 4 1 4	300	45	..
	..	Sonya class	Coast minesweeper	P: D Cann	USSR USSR	 4	400	18	..
	Gorky/Sudomekh	Tango class	Sub	P: D ShSu	 USSR	 16	3 000	20	..
	..	Turya class	Hydrofoil TB	P: D Cann	USSR USSR	 4	200	40	..
	..	Victor-2 class	Nucl sub	P: N ShSu	USSR USSR	 8	4 700	33	..
6 Yugoslavia	Soko	G-2A Galeb	Trainer/ground attack	P: TJ	UK		2 620	730	1 240
	Soko	G-2AE Galeb	Trainer/ground attack	P: TJ	UK		2 620	756	1 240
	Soko	J-1 Jastreb	Fighter	P: TJ	UK		2 820	740	1 520
	Soko	J-1E Jastreb	Fighter	P: TJ	UK		2 820	740	1 520
	Soko	RJ-1 Jastreb	Recce	P: TJ Bomb	UK		2 820	740	1 520
	Soko	RJ-1E Jastreb	Recce	P: TJ	UK		2 820	740	1 520
	Soko	TJ-1 Jastreb	Trainer	P: TJ Bomb	UK		2 980	820	..
		..	Frigate	P: GT	UK		2 000	..	..
	Uljanik Yard	Improved Heroj	Sub	P: DE Elec Mine TT	 USSR USSR USSR	 20 6	964	16	..
	..	..	LST	P: D Cann	 Swe	 2	2 980	..	..
	Brodotehnika	Nestin class	River minesweeper	P: D Cann	 Swi	 3	65	15	..
	Tito Yard	Rade Koncar	FPB	P: GT Cann ShSh	UK/ FRG Swe USSR	 2 2	240	40	500
International:									
16 Belgium/ France/ Netherlands	..	Modified Circe	Minehunter	P: D Cann	Neth	 1	510	15	3 000
16 Belgium/ FR Germany/ Netherlands	Sabca/VFW-Fokker	VFW-614	Transport				12 180	713	1 204
16 Brazil/Italy	EMBRAER/ Aermacchi	MB-340	Fighter	P: TF	UK		..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1976	..	..	3	..	..	New class reported in 1976; to replace Osa class
..	..	1973	4	..	15	..	..	
..	..	1973	2	..	7	..	..	
..	..	1973	5	..	30	..	..	
..	..	1975	2	..	5	..	..	
1957	1961	1963	..	..	..	..	..	Version for Yugoslavian AF
..	1974	..	..	..	..	..	..	Export version of G-2A, first produced for Libya
..	..	1963	..	..	..	..	..	Version for Yugoslavian AF; 5 versions in production: J1-G, RJ-1, RJ-1E, TJ-1
..	..	1970	..	..	..	..	..	Export version of J-1
..	1976	..	..	..	..	..	..	
..	1976	..	..	..	..	..	..	
..	1974	1975	..	..	..	..	..	
1978	..	..	..	1	..	..	..	
1977	..	..	..	2	..	..	..	
1977	..	..	..	1	..	..	..	Capacity: 1 hel, 6 tanks; arms: 2 × 40-mm Bofors cannon
..	..	1975	1	4	..	..	..	Arms: 3 × 20-mm Hispano Suiza cannon
..	1976	1977	2	..	10	..	..	Weight: full-load; arms: 2 × SSN-2 Styx ShShM, 2 × 57-mm Bofors cannon
1976	..	1979	..	45	..	..	..	
..	1971	1977	..	..	5	..	..	VFW-Fokker design leadership: developed with government funding; total number produced: including 3 for FRG Air Force
1977	1978	..	..	..	..	..	..	Proposed joint project at development stage

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
16 France/ FR Germany	Dassault/Dornier	Alpha Jet	Fighter/trainer	P: TF	Fra/ FRG		3 352	1 040	2 871
				AAM		2			
				ASM		4			
				Bomb		8			
				Nap		6			
				RL		6			
	Euromissile	C-160F Transall	Transport	P: TP	UK		28 758	783	4 800
	Euromissile	PAH-2/HAC	Hel	P: TS	Fra/ FRG		703	..	..
				ATM		6			
	Euromissile	AS-2L	ASM				..	..	..
	Euromissile	AS-34 Kormoran	AShM				160	..	..
	Euromissile	HOT	Landmob/Port ATM	P: S			6	950	4
	Euromissile	Milan	Landmob/Port ATM	P: S			3	720	2
	Euromissile	Roland-2	Landmob SAM	P: S			6	1 958	6
	Euromissile	Roland-2S	Landmob SAM				6	1	30
	Euromissile	Atem	ATM				..	..	..
	Euromissile	NATO-ASSM	AShM/ShShM/ SuShM				..	..	..
16 France/Italy	Matra/ Oto Melara	Otomat-2	ShShM				..	..	100
	Matra/ Oto Melara	Otomat-2/ Teseo	Fixed/Landmob SShM				..	..	200
16 France/UK	Dassault/BAC	Jaguar	Fighter	P: TF	UK		7 000	1 836	4 210
				Cann		2			
	Aérospatiale/ Westland	Lynx	Hel	P: TS	UK		..	..	..
	Aérospatiale/ Westland	SA-330L Puma	Hel	P: TS	Fra		3 590	294	572

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1969	1973	1977	..	..	56	..	..	Version E-1 produced in France; version A-1 produced in FRG; production rate of both versions by 1979: 15/month; France ordered 200, FRG ordered 175; both France and FRG have complete sales rights
1977	..	1980	..	25	..	..	8.5	Relaunch of production line 1977 (completed 1972); no final assembly in FRG; VFW/MBB to produce 50.6% of airframe and P
1978	..	1986	..	..	..	..	..	Project definition phase to begin 1978; first delivery planned 1986
1978	..	..	..	..	..	..	..	Now being proposed for development
1962	1970	1976	..	..	..	..	1.2	Euromissile project initiated by FRG to meet navy requirement; for Tornado
1964	1971	1975	18 000	(72 000)	..	..	..	By Apr 1978, 67 000 sold to 17 armies; 3 versions in production
1962	1964	1972	..	..	..	..	..	
1964	1971	1977	..	..	..	..	3.2	Planned procurement: 340 launchers and 12 100 missiles for FRG, 104 launchers and 4 450 missiles for France to be completed by 1982
..	..	..	..	..	..	..	..	
(1977)	..	..	..	..	..	..	..	
(1977)	..	..	..	..	..	..	..	
..	1974	1975	..	..	..	..	..	
..	1976	..	..	..	..	..	..	Coastal defence version under development; 1 system: command and control section, and firing section, with 2 launch vehicles and support equipment
1965	1969	1972	14	..	81	..	..	Versions A/E for France; versions S/B for UK; export version known as Jaguar International
1968	1972	1976	..	..	..	..	..	Netherlands Navy designation: UH-14A; UK Navy designation: HAS-2; Aérospatiale to have 30% of production, Westland 70%; Westland design leadership
..	1976	1977	96	..	..	..	..	Current production version; Aérospatiale to have 80% of production, Westland 20%; Aérospatiale design leadership; designation SA-330J is civilian version

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment Type	Coun-try	Num-ber	Technical data Wt	Speed	Range
	Aérospatiale/ Westland	SA-332	Hel				..	..	..
	Aérospatiale/ Westland	SA-341H Gazelle	Hel	P: TS			..	310	..
	Aérospatiale/ Westland	SA-342L Gazelle	Hel				955	310	755
	Aérospatiale/ Westland	SH-13A	Hel	P: TS	UK		2 629	273	1 266
16 FR Germany/ Italy/UK	Panavia	Tornado ADV	Fighter				10 430	2 692	..
	Panavia	Tornado IDS	Fighter				..	2 692	..
16 FR Germany/UK	Rheinm./Vickers	SP-70-155	SPH	MG	UK	2	..	..	..
16 FR Germany/Japan	MBB/Kawasaki	BK-117	Hel	P: TS	USA		1 400	264	545
16 FR Germany/UK	VFW/Westland	P-227	Hel	P:	UK		4 763	287	..
	Krupp, MVEE	FMBT-80	MBT				..	..	..
16 FR Germany/USA	MBB/MDD	..	ASM				..	..	..
16 Romania/ Yugoslavia	CIAR/Soko	Orao	Fighter/ground attack	P: TJ Cann	UK	 2	4 318	1 162	741

Year design began	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	1978	1980	..	..	..	..	..	
..	1967	1971	..	..	..	..	..	
..	..	1977	..	..	..	..	..	Military version of SA-342J
1968	1971	1974	..	..	..	..	..	
1969	1976	..	..	..	..	..	21.0	Unit cost increase of 22% since programme began in 1970 according to UK government; formerly known as Panavia MRCA
1969	1978	..	..	..	..	..	17.0	R&D cost-sharing: FRG 48.4%, Italy 14.4%, UK 37.2%; Netherlands withdrew from project; planned u.c. was $5.7 mn
1968	1970	1977	..	..	..	..	..	
1977	1979	1981	..	..	..	35.0	..	New project; superseded Bo-107/KH-7; share of development cost of $35 mn: 50/50; agreement signed in 1977, delivery planned in 1981
1977	..	..	..	..	..	..	..	Project in doubt due to FRG government backing of PAH-2
1972	..	1980	..	..	..	..	..	Under development to replace Leopard and Chieftain
1978	..	..	..	..	..	..	..	
1971	1974	1977	..	280	9	..	..	First aircraft produced flew 1977; total requirement: 200 for Yugoslavia, 80 for Romania; trainer version planned

II. Register of licensed production of major weapons in industrialized countries, 1978

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment Type	Standard equipment Country
7 Austria	..	Israel	Kfir-C2	Fighter		
11 Australia	..	UK	PCF-420	FPB		
4 Belgium	Sabca	France/FRG	Alpha Jet	Trainer		
	Behrman	Ireland	Timoney	APC		
	Sabca/Fairey	USA	F-16A	Fighter/strike		
	Sabca/Fairey	USA	F-16B	Fighter/strike		
	..	USA	AIM-9L	AAM		
	..	USA	Seasparrow	ShShM		
4 Canada	Diesel Div	Switzerland	Piranha	AC	Gun MG	UK UK
3 China	..	UK	HS Harrier	Fighter		
5 Czechoslovakia	..	USSR	T-62	MBT		
7 Finland	Valmet	UK	HS Hawk-1	Trainer		
4 France	Reims	USA	Cessna F 337	Trainer		
	Reims	USA	R-172 Hawk XP	Lightplane		
	Aérospatiale	USA	MIM-23B	Landmob SAM		
4 FR Germany	..	USA	AIM-9L	AAM		
	..	USA	Seasparrow	ShShM/ShAM		
4 Greece	..	France	Combattante-2 class	FPB	ShSh	Norway
		France	Combattante-3 class	FPB		
5 Hungary	..	Czechoslovakia	OT-64	AC		
4 Italy	..	FRG	Leopard-1	MBT		
	..	FRG	AIM-7E	AAM		
	..	FRG	Cobra-2000	ATM		

Year of licence	Year in production	Current annual production rate	Total number planned	Total number produced	Programme cost	Unit cost	Comments
2000	..	..	..	..	..	..	
1977	..	..	14	..	..	..	Designation: Brooke Marine 42M
1975	1978	..	17	3	..	..	First aircraft delivered from France in Jun 1978; first Belgian-assembled was completed in Nov 1978; production rate 1979: 2/month
1977	1978	..	1 000	..	..	..	
1977	1978	..	104	..	..	..	
1977	1978	..	12	..	..	..	
1977	1978	..	1 224	..	..	..	NATO production group: Belgium, FRG, Norway, UK; allocation decided in Dec 1977; main contractor to be decided in Dec 1978
1973	1978	48	96	..	..	..	Part of NATO Seasparrow programme; for Westhinder-class ships
1977	1978	..	350	25	..	..	
1979	..	..	70	..	..	..	
1970	..	..	..	..	..	..	
1977	..	..	46	..	..	..	
1969	..	6	..	70	..	..	Designation: FTB-337 Milirole; exported to Africa
1976	1976	..	..	..	..	..	
1974	1976	..	..	..	..	..	
1977	1978	..	9 510	..	..	..	
1977	..	..	96	..	..	..	FRG joined NATO Seasparrow production group in 1977
1976	..	..	4	..	..	..	
1974	1978	2	6	4	..	..	
..	..	..	..	..	..	..	
1972	1973	18	600	..	..	..	
..	..	..	..	..	..	..	Licence-procured from FR Germany for US design
1974	..	1 000	..	..	..	..	

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment	
					Type	Country
	Agusta	USA	AB-205	Hel		
	Agusta	USA	AB-206B-2	Hel		
	Agusta	USA	AB-206B-3	Hel		
	Agusta	USA	AB-206B-LR	Hel		
	Agusta	USA	AB-212	Hel		
	Agusta	USA	AB-212AS	Hel	ASM	
	Agusta	USA	AB-214A	Hel		
	Agusta	USA	CH-47C Chinook	Hel		
	Aeritalia	USA	F-104S	Fighter		
	Bredanardi	USA	Hughes-300C	Hel		
	Bredanardi	USA	Hughes-500MD	Hel	ATM	USA
	Agusta	USA	S-61R	Hel		
	Agusta	USA	SH-3D	Hel		
	..	USA	M-109	SPH		
	..	USA	M-113-A1	AC		
	..	USA	Seasparrow	ShAM/ShShM		
10 Japan	Mitsubishi	UK	T-2	Trainer	AAM Cann	
	Fuji	USA	Bell UH-1H	Hel		
	Mitsubishi	USA	F-15A Eagle	Fighter/Interc		
	Kawasaki/ Mitsubishi	USA	F-4EJ Phantom	Fighter		
	Kawasaki	USA	Hughes-500C	Hel		
	Kawasaki	USA	Hughes-500D	Hel		
	Kawasaki	USA	KV-107/2A-5	Hel		
	Kawasaki	USA	OH-6J Kiowa	Hel		
	Kawasaki	USA	P-2J Neptune	ASW/Mar patrol		
	Kawasaki	USA	P-3C Update-2	ASW/Mar patrol		
	Mitsubishi	USA	S-61B	Hel		
	Mitsubishi	USA	TF-15A Eagle	Trainer		
	Mitsubishi	USA	AIM-7E	AAM		
	Mitsubishi	USA	MIM-23B Hawk	SAM		

Year of licence	Year in pro-duction	Current annual pro-duction rate	Total number planned	Total number pro-duced	Pro-gramme cost	Unit cost	Comments
1969	1969	120	..	600	..	..	
1972	1972	50	900	900	..	..	
1978	1979	50	..	..	..	..	
1978	1979	..	..	..	..	..	Long-range version at test stage
1970	1970	..	..	..	..	..	
1975	1976	60	87	..	..	..	
1977	1978	10	..	10	..	..	
1968	1970	12	126	..	..	..	
1966	1968	24	245	205	..	..	
1975	1976	12	..	..	..	..	
..	1977	12	500	..	..	..	
1972	1976	6	20	..	..	..	
1965	1967	12	34	..	..	..	
1968	1971	18	200	..	..	..	
1963	1965	..	6 000	..	..	..	
1977	1978	50	..	..	..	..	
..	1972	..	59	35	..	..	
1973	1973	..	54	..	..	..	
1977	1978	..	78	..	..	17.7	Total programme cost expected to be $3 300 mn; AF wants 23 more; planned delivery in 1981
1969	1972	15	126	126	..	..	First 2 delivered from USA, 8 delivered in assembly form, rest completely manufactured in Japan; production reportedly completed in 1978
1972	..	20	200	170	..	..	
1978	1978	..	15	..	..	..	
1962	1971	..	36	..	..	..	Local modification of Boeing-Vertol 107; first delivered to Sweden in 1972; FY 1978 funding: $8.90 mn for 3
1967	1969	12	120	..	..	..	FY 1978 funding: $6.25 mn for 10
..	1969	..	82	80	..	..	
1977	..	..	45	..	..	..	
1965	1965	4	97	80	..	..	Designation: including S-61B-1 version; 4 more ordered by navy in FY 1978
1977	1978	..	10	..	..	17.7	
1972	1973	90	..	600	..	..	
1977	1978	..	..	..	..	..	

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment Type	Standard equipment Country
4 Netherlands	Fokker-VFW	USA	F-16A	Fighter		
4 Norway	..	FRG	..	Sub		
	..	USA	AIM-9L	AAM		
5 Poland	..	Czechoslovakia	OT-64	AC		
	..	USSR	T-62	MBT		
5 Romania	..	China	Shanghai class	FPB	Cann MG	
	ICA-Brasov	France	SA-316B	Hel		
	GAB	UK	BAC-111	Transport		
	..	UK	BN-2A Defender	Transport		
7 Spain	..	France	AMX-30	MBT		
	Bazan	France	Agosta class	Sub	SuSh	France
	CASA	FRG	Bo-105CB	Hel		
	Bazan	USA	FFG-7 class	Frigate	Cann Hel ShSh	 USA
7 Switzerland	..	Austria	Pinzgauer	LT		
	FFA	USA	F-5E Tiger-2	Fighter		
4 Turkey	..	FRG	Cobra-2000	ATM		
	Taskizak Yard	FRG	Jaguar-3 class	FPB	ShSh Cann	USA Italy
	..	FRG	SAR-33 class	PB	Cann ShSh	
	..	FRG	Type 209	Sub		
4 UK	BAC	France/FRG	Milan	ATM		
	Westland	USA	Commando MK-2	Hel		
	Westland	USA	SH-3D	Hel		
	..	USA	AIM-9L	AAM		

Year of licence	Year in production	Current annual production rate	Total number planned	Total number produced	Programme cost	Unit cost	Comments
1977	1978	..	174	..	..	..	Total number planned: 102 for Netherlands plus 72 for Norway; first to be delivered in 1979; production rate 1984: 3/month; offset for Netherlands' industry involves 250 jobs
2000	..	..	3	..	..	..	First to be purchased directly from FRG, for total of 4
1977	1978	..	432	..	..	..	4-nation production group for Super Sidewinder AAM; for F-16
..	..	..	..	..	..	..	
1970	..	..	..	..	..	..	
1971	1973	3	..	18	..	..	
1971	1971	10	130	..	..	..	
1978	..	..	80	..	..	..	
1968	1969	46	315	272	..	..	
1972	1974	..	..	180	..	..	
1974	1981	2	6	4	..	..	
1978	..	..	..	..	..	..	
1977	1981	1	3	..	..	..	
1978	..	..	2 000	..	..	..	
1977	..	..	53	..	..	..	Total number planned: excluding 13 F-5E and 6 F-5F delivered from USA
..	..	..	..	..	..	..	
1973	1978	2	3	..	..	..	
1976	..	..	13	..	..	..	Prototype delivered from FRG in 1977 for trials; rest of building in Turkey
1974	..	..	2	..	..	..	Total number planned: 2 delivered from FRG 1975–77
1976	1977	..	50 000	..	..	..	
1966	1972	..	..	200	..	..	
1966	1969	20	..	200	..	..	
1977	1978	..	..	..	..	..	4-nation production group for Super Sidewinder; for 102 F-16 aircraft

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment Type	Standard equipment Country
1 USA	Boeing/Hughes	France/FRG	Roland-2	SAM		
	Fairchild	Netherlands	FH-227	Transport		
	Fairchild	Switzerland	AU-23A Peacemaker	Transport		
	MDD	UK	AV-8B Harrier	Fighter	Cann AAM Bomb ECM	UK/USA USA USA USA
6 Yugoslavia	Soko	France	SA-342 Gazelle	Hel		
	..	USSR	AT-3	ATM		

Year of licence	Year in pro-duction	Current annual pro-duction rate	Total number planned	Total number pro-duced	Pro-gramme cost	Unit cost	Comments
1974	1979	314	6 000	157	265.0	3.2	Cost escalation by 1978 of 56.7 %; planned production for 1979: 15 launch units and 314 missiles; Norway may buy US launch units but missiles from Euromissile
1964	1965	..	..	..	..	..	
1965	1970	20	..	..	..	..	
1975	1982	..	350	..	..	..	Designation: Advanced Harrier, UK origin; USA continued study when UK withdrew from joint programme in 1975; for US Marine Corps
1971	1973	10	132	..	..	..	
..	..	..	..	..	..	..	

Appendix 2B

Registers of indigenous and licensed production of major weapons in Third World countries, 1978

I. Register of indigenously designed major weapons in development or production in Third World countries, 1978

For sources and methods, see appendix 3C. For conventions, see page 252.
Note: See note to appendix 2A, page 72.

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
15 Argentina	Cicaré	CK-1	Helicopter				469	163	480
	FMA	IA-58 Pucará	Trainer/COIN	P: TP			4 037	485	3 042
	FMA	IA-63	Trainer	P: TJ			..	..	..
	CITEFA	..	ASM				40	..	7
	CITEFA	..	ATM				..	..	..
	Menghi y Penco	Costa Sur class	Transport				4 600	15	..
	AFNE	..	LST	P: D Hel		 1	4 300	16	..
	Astarsa	Puerto Deseado	Survey	P: D			2 100	12	..
	Alianza	..	Survey				1 960	..	..
15 Brazil	EMBRAER	EMB-110	Transport	P: TP	Can		3 380	558	2 220
	EMBRAER	EMB-110A	Nav calibration	P: TP	Can		..	..	..
	EMBRAER	EMB-110B	Photo survey				..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost ($ mn)	Unit cost ($ mn)	Comments
1973	1976	..	..	..	5	..	..	Designation: formerly known as Cicaré Colibri; redesign work started in 1975; for use as trainer/ agricultural aircraft
..	1969	..	24	..	22	..	..	Total requirement: 100; production rate increased to 4/month; trainer version under development
1977	..	..	..	..	..	..	..	Developed to meet AF requirement; replaces earlier project IA-62; total requirement: 100
..	1978	..	..	..	..	..	..	Navy programme; preliminary production of 8 test vehicles completed, 50 missiles to be produced for evaluation
1974	..	1978	..	..	..	..	..	Similar to FRG Cobra; developed over 4 years; Argentina produces 68% of the components; to enter service in 1979
1977	..	1978	2	3	..	..	..	Weight: gross weight
..	1968	1978	1	1	..	..	..	Name: Cabo San Antonio: completion delayed
1947	1976	1977	1	..	2	..	..	
1974	..	..	..	..	1	..	..	
..	1968	1972	..	..	56	..	..	Brazilian military designation C-95; standard version
1974	..	1976	..	..	4	..	..	Brazilian military designation EC-95: 4 delivered to Brazilian AF by Jan 1978
1974	..	1976	3	..	6	..	..	Brazilian military designation R-95: 6 delivered to Brazilian AF by Jan 1978

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	EMBRAER	EMB-110K1	Mil freigher	P: TP	Can		3 394	460	1 918
	EMBRAER	EMB-110N	Transport				..	..	..
	EMBRAER	EMB-111	Mar patrol	P: TP			..	..	..
	EMBRAER	EMB-121 Xingu	Transport	P: TP	Can		3 476	500	2 410
	EMBRAER/ Neiva	EMB-312	Trainer	P: TP	USA		..	..	..
	..	IPAE-26	Lightplane				..	..	..
	Neiva	T-25 Universal 1	Trainer	P: PI	USSR		1 150	500	1 500
	Neiva	T-25 Universal 2	Trainer				..	320	515
	AEROTEC	Uirapuru-122A	Trainer				540	307	..
	AEROTEC	Uirapuru-132	Trainer				..	..	..
	Engesa	EE-11 Urutu	APC	P: D	France		11	95	700
	Engesa	EE-17 Sucuri	TD	P: D Gun MG	 Brazil Brazil	 1 1	18	95	600
	Engesa	EE-9 Cascavel	Recce AC	Gun	Fra	1	12	100	800
	Engesa	T1-A1 Cutia	Recce AC	P: D MG	Brazil Brazil	 1	3	80	370
	AVIBRAS	MAS-1 Carcara	ASM	P: S			9	..	..
	Army D&R Inst	..	SAM				..	..	..
11 Fiji	Suva Naval Base	..	Survey				..	..	..
9 India	HAL	..	Hel	P: TS	France		1 500	240	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1974	..	1976	4	20	..	..	..	Brazilian military designation C-95A; used as freighter/paratroop transport; 8 delivered to Brazilian AF by Jan 1978
..	..	..	..	..	56	..	..	Designation: EMB-110C; basic export version and standard commercial version
1973	1977	1977	12	..	3	..	..	Brazilian military designation P-95; replacing Neptunes; first delivered to Brazilian Navy Apr 1978
1974	1976	1977	2	5	..	..	..	Brazilian AF now receiving first of 5 ordered
1978	1980	..	..	..	..	..	..	
..	1978	..	..	..	..	..	..	Developed for army/agricultural use
1963	1966	1971	..	150	160	..	..	Production line reopened in 1978; total number planned: 150 in service with Brazilian AF; delivery started of second order of 12; further order of 20 expected soon
..	1978	1979	..	..	..	..	..	Development of new COIN version received government funding; Brazilian AF requirement: 100
..	1965	..	48	..	128	..	..	Designed as private venture; total sold: 128 when production temporarily ceased in 1978
1977	..	..	..	..	..	..	..	Production of model 122 ceased; new funds released for development of model 132
1970	1970	1972	..	..	..	..	..	
..	1976	1977	..	..	..	..	..	
1970	..	..	..	..	..	..	..	
1960	..	1966	..	..	(100)	..	..	
1973	..	..	..	..	..	..	..	TV-guided ASM developed to meet army requirement; current status unknown
..	1976	..	..	..	..	..	..	Prototypes produced of 2 versions of long-range SAM, developed by Army Development and Research Institute; no further details known
1978	..	1979	..	..	1	..	..	
1973	1981	..	..	..	..	65.0	..	For ASW/recce use; R&D cost for navy and army/AF versions

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	HAL	HF-24 Marut-1	Fighter/ground attack	P: TJ	UK/ India		6 208	1 468	1 444
	HAL	HF-24 Marut-1T	Trainer	P: TJ	UK/ India		6 250	..	1 445
	HAL	HF-25	Fighter				..	..	..
	HAL	HF-73	Fighter/strike				..	2 448	..
	HAL	HJT-16 Kiran-2	Trainer/COIN	P: TJ Bomb Rock	UK		..	..	..
	HAL	HPT-32	Trainer	P: P	USA		1 034	233	1 199
	Garden Reach	Improved Abhay	FPB	P: D Cann	UK	 1	140	28	..
	Garden Reach	Sandhayak	Survey	P: D			1 200	..	..
	Garden Reach	Seaward MK-2	CPB				..	..	..
	Mazagon Docks	..	Tanker	P: D	FRG		9 430	15	..
10 Indonesia	LIPNUR	LT-200	Trainer	P: P	UK		409	219	613
	..	LCM type	CPB	P: D			147	21	..
8 Israel	IAI	Arava Maritime	Mar patrol				..	..	..
	IAI	Arye	Fighter/strike				..	..	..
	IAI	..	Hel	P: TS	France		..	..	..
	IAI	IAI-201 Arava	Transport	P: TP			..	319	1 297
	IAI	IAI-202 Arava	Transport	P: TP			..	319	..
	IAI	Kfir-C2	Fighter/bomber				..	2 692	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1956	1961	1964	..	..	125	9.2	..	Production of aircraft and licence production of P completed; R&D cost by 1975: $9.22 mn; P problem never satisfactorily solved: recent report criticized attempt in 1960s to develop engine jointly with Egypt
1956	1970	1976	..	..	15	3.7	..	Production completed; can serve as advanced trainer and all-weather trainer
1977	..	1985	..	..	..	..	..	Further development depends on government agreement; Soviet assistance reported
1969	1980	..	..	..	..	..	..	Designation now understood as new aircraft (previously believed to be HF-24 Marut-2 and Marut-3); planned P: RB-199
1974	1976	1979	..	..	..	..	..	Armed version of Kiran-1; development phase completed 1978
1974	1977	1979	..	..	..	..	..	To replace HT-2; test programme completed 1978; delivery planned 1981–82
..	1976	1976	..	..	4	..	..	3 under construction; further 4 planned
..	1977	1979	..	1	..	..	..	
..	..	..	..	..	..	..	..	
..	1977	..	..	2	..	..	..	Under construction for Iran
1973	1974	1976	20	..	..	..	..	Derivative of Pazmany PL-2, previously produced under licence; large number to be built
..	..	1976	5	13	..	..	..	
..	..	1977	..	..	..	..	..	Naval version offered 1977
1978	..	1985	..	..	..	600	..	Production decision pending US sales of F-16; programme cost: R&D $600 mn plus $7 mn for 200; planned delivery 1986–87; no US components
1977	..	..	..	..	..	..	..	At design study stage; may carry ATM
1966	1972	..	36	..	86	..	..	
..	..	1973	..	..	..	..	..	
..	..	1974	36	..	125	..	4 500	Basic version in production for Israel and export; approximately 45% US components, including P and avionics; Israel still expects export sales of 300; interest from at least 12 countries reported

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	IAI	Sea Scan	Coast patrol	P:	USA		..	870	4 600
	IAI	Westwind 1125	Transport				..	..	..
	IAI	Westwind-1	Coast patrol	P: TF	USA		4 667	871	..
	Soltam	L-33	SPH	P: D Gun MG	Israel		41	36	260
	Soltam	M-68	SPH				..	..	..
	..	Merkava	MBT	P: Cann	USA		56	..	..
	IAI Ramta Div.	RBY-1	ARV	P: P Gun MG	UK Israel Israel	 2 4	..	100	550
	IAI	Gabriel-2	ShShM	P: S			180	856	41
	IAI	..	ShShM				..	..	..
	Rafael	Shafrir-2	AAM				11	..	5
	Rafael	Shafrir-3	AAM				..	..	..
	Israel Shipyard	..	Corvette	P: GT ShSh ShSh Cann RL Hel	USA Israel USA Italy Swe	 4 2 2 1	850	42	4 500
	Israel Shipyard	Dvora class	FPB	P: D ShSh Cann	FRG Israel	 2 2	47	27	700
	Haifa Shipyard	Reshef class	FPB	P: D ShSh ShSh Cann Cann	FRG Israel USA Italy Swi	 6 4 2 2	415	32	1 650
10 Korea, North	..	Chaho class	GB	P: D Cann RL		 8 4	80	40	..
	..	Chong Jin class	GB	Cann RL		8 4	80	40	..
	..	LCM type	LC				..	..	..
	..	LCU type	LC				..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
1978	..	..	..	..	..	..	..	Version of Westwind 1125
..	1980	..	..	..	..	..	..	
..	..	1978	24	..	24	..	..	Maritime patrol version of civilian 1124 for navy; design: originally Jet Commodore; production line purchased from USA
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
1970	..	1977	..	..	..	..	0.7	
..	..	1975	..	..	..	..	..	
..	..	1972	..	..	..	..	..	New version announced in 1972
1976	..	1982	..	..	..	..	..	Reported under development 1976; for service mid-1980s; designation unknown
1965	..	1969	..	..	..	..	..	
1978	..	..	..	..	..	..	..	
1976	..	..	..	8	..	..	..	2 under construction, 6 more planned; arms: Gabriel and Harpoon ShShM, 2 × 76-mm Oto Melara cannon, 1 twin Bofors 375-mm
..	1977	..	..	..	2	..	..	Local development from US-supplied Dabur-class design; smallest missile ship built; arms: 2 × Gabriel ShShM
..	1973	1973	2	..	21	..	..	Arms: 2 × Gabriel ShShM, Harpoon from 1978, 2 × 76-mm Oto Melara cannon, 2 × 20-mm Oerlikon cannon
..	..	1974	15	..	(60)	..	..	Reported in production since 1974; based on Soviet-designed P-6 hull; weight: full load; may be licence production
..	..	1975	10	..	(30)	..	..	Similar to Chaho class; weight: full load; may be licence production
..	..	1976	5	..	(15)	..	..	15 reported in use 1978, seen in waters close to South Korea; no data available; may be licence production
..	..	1975	4	..	(10)	..	..	May be licence production

Region code/ Country	Manufacturer	Weapon designation	Weapon description	Standard equipment: Type	Standard equipment: Country	Standard equipment: Number	Technical data: Wt	Technical data: Speed	Technical data: Range
	..	Midget	Sub				..	..	..
	..	Najin class	Frigate	P: D Cann RL Mort TT Mine		 18 4 2 3 30	1 500	26	4 000
	..	Nampo class	LC	P: D MG		 6	82	40	375
	..	Sohung class	FPB	P: D			70	30	400
	..	Taechong class	PB				..	..	..
15 Peru	Sim Callao	..	Survey				1 200	..	..
	Sim Callao	Talara class	Repl tanker	P: D			25 000	15	..
10 Philippines	NAMC	..	Light plane	P: P	USA		992	312	785
	PAF	T-610 Super Pinto	Trainer/COIN	P: TJ Cann MG Rock	USA		1 542	843	2 062
	PAF	XT-001	Trainer	P: P	USA		720	260	..
13 South Africa	Atlas	C-4M Kudu	Transport	P: P	Italy/ USA		..	..	..
9 Sri Lanka	Colombo Yard	..	CPB	P: D Cann	UK	 2	57	14	1 200
10 Taiwan	AIDC	AT-3	Trainer	P: TJ	USA		..	..	..
	AIDC	TC-H1	Trainer	P: TP Elec	USA USA		..	..	..
	AIDC	XC-2	Transport	P: TP	USA		5 896	407	574
10 Thailand	..	..	Trainer	P: P			..	..	..
	Royal Thai Yard	..	CPB	P: D Cann		 2	87	25	..
15 Trinidad	Tugs Lighters	..	CPB	P: D	USA		..	..	..

Year design begun	Year of first proto-type test	Year in pro-duction	Current annual produc-tion rate	Total number planned	Total number pro-duced	Develop-ment cost	Unit cost	Comments
..	..	1974	1	..	(5)	..	..	Reported in production since 1974; may be licence production
1971	1973	1975	1	..	(4)	..	..	May be licence production
..	..	1975	20	..	(70)	..	..	May be licence production
..	..	..	..	..	..	..	..	May be licence production
..	..	1971	1	..	(2)	..	..	May be licence production
1977	..	1978	1	..	1	..	..	
1975	1976	1977	1	..	2	..	..	
1975	1978	..	..	..	..	..	..	
1977	..	..	..	..	..	..	..	Philippines purchased design and prototype rights from US American Jet (1968 design)
..	1975	..	..	..	..	..	..	Close resemblance to Italian SF-260MP; developed by AF
..	1975	..	..	..	..	..	..	
..	..	1976	1	3	..	..	..	Could be licence produced; ordered 1976
1975	1978	..	..	..	..	..	..	Developed from T-38 Talon; development delayed by US veto of technical assistance
1970	1973	1976	12	..	36	..	..	
1973	1978	..	..	..	..	..	..	At final stage of prototype construction; same P as for Bell 0H-1H, licence produced
..	1978	..	..	..	..	..	..	
..	..	1971	..	3	..	..	..	First 2 completed 1971; third laid down 1977
1978	..	..	..	1	..	..	..	

II. Register of licensed production of major weapons in Third World countries, 1978

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment	
					Type	Country
15 Argentina	..	France	AMX-13	LT		
	..	FRG	..	MT	Gun MG	FRG FRG
	..	FRG	..	Sub		
	Rio Santiago	FRG	Type 148	FPB	ShSh	Israel
	AFNE Shipyard	UK	Type 21 Amazon class	Frigate	Cann ShSh ShSh Hel	Switzerland France UK UK
	..	UK	Type 42	Frigate	Cann Hel ShAM	Switzerland UK UK
	Chincul	USA	Arrow-3	Trainer		
	FMA	USA	Cessna-A150	Trainer		
	FMA	USA	Cessna-A182	Lightplane		
	RACA	USA	Hughes-500M	Hel		
15 Brazil	Helibras	France	Ecureuil	Hel		
	Helibras	France	SA-315B	Hel		
	..	FRG	Cobra-2000	ATM		
	..	Israel	Kfir-C2	Fighter		
	EMBRAER	Italy	EMB-326GB	Trainer/COIN	ASM	France
	Arsenal do Rio	UK	Niteroi class	Destroyer	RL ShSh	Sweden France
	EMBRAER	USA	EMB-810C	Lightplane		
15 Colombia	Urdaneta	UK	BN-2A Defender	Transport		
8 Egypt	..	France	Alpha Jet	Trainer/ground attack		
	..	France	Mirage-2000	Fighter		
	Helwan	UK	Lynx	Hel		
	Al Kharj	UK	Swingfire	ATM		

Year of licence	Year in production	Current annual production rate	Total number planned	Total number produced	Programme cost ($ mn)	Unit cost ($ mn)	Comments
1969	..	12	..	..	..	..	
1976	1980	..	200	..	..	..	
1977	..	..	4	..	..	..	
1975	..	..	2	..	..	..	
1975	..	..	6	..	..	..	
1970	1978	..	..	..	..	..	
1977	..	10	..	..	..	..	Local development of licence-produced Piper aircraft; for use as military trainer
..	1971	6	..	45	..	..	
1971	1966	15	500	160	..	..	Produced in USA, completed in 1976; licence contract of 1965 extended in 1971
1972	1973	12	120	48	..	..	Assembly of knocked-down components
1977	1979	..	200	..	..	0.2	France owns 45% of new company; production run planned for 1978–88; most civilian versions, some military
1977	1979	..	30	..	..	..	France owns 45% of new company; assembly of 30 over 10 years, most for civilian market
1973	1960	10	..	..	9.0	..	
2000	..	..	..	..	..	..	
1970	1971	4	167	130	..	..	Designation: AT-26 Xavante; first licence production contract in 1970 for 112, second order 1975 for 40 plus option on 30 more
1970	1978	2	..	2	..	..	2 produced in Brazil, 4 delivered from UK in 1976–78; Brazilian-produced are general-purpose version with Exocet ShShM
1974	1975	48	..	118	..	..	Designation: Piper Seneca-2; licence production contract includes 6 versions, mostly for civilian market; 10 delivered to Brazilian AF in 1978; production slowed down
1977	..	..	..	..	..	..	Reported in 1977 that Colombia would start licence production; no further information
1978	..	..	160	..	..	..	
1978	..	..	..	..	..	..	
1978	1980	..	250	..	38.0	..	Licence production contract signed in 1978 for 280 hel and 750 Rolls-Royce P; AOI funding
1977	1978	..	5 000	..	75.0	..	Arab-British Dynamics Ltd set up with 30% of the capital from BAC and 70% from AOI; initial contract value $77.6 mn; planned production run: 7 years

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment Type	Standard equipment Country
9 India	HAL Bangalore	France	SA-315B Lama	Hel		
	HAL Bangalore	France	SA-316B Alouette-3	Hel		
	Bharat	France	R-550 Magic	AAM		
	Bharat	France	SS-11	ATM		
	HAL	UK	Gnat T-2 Ajeet	Trainer		
	HAL Bangalore	UK	Gnat-2 Ajeet	Trainer	Cann	UK
	HAL Kanpur	UK	HS-748M	Transport		
	..	UK	Jaguar	Fighter		
	Avadi	UK	Vijayanta-2	MT		
	Mazagon	UK	Leander class	Frigate	Hel ShAM	UK UK
	HAL Nasik	USSR	MiG-21bis	Fighter		
	HAL Nasik	USSR	MiG-21M	Fighter	AAM	USSR
	Bharat	USSR	AA-2 Atoll	AAM		
10 Indonesia	Nurtanio	France/UK	SA-330PL Puma	Hel		
	Nurtanio	FRG	Bo-105CB	Hel		
	Nurtanio	Spain	C-212A	Transport		
8 Iran	Irano-British Dynamics	UK	Rapier	Tracked SAM		
	..	USA	Bell-214A	Hel	Elec	USA
	..	USA	Bell-214ST	Hel		
	IEI/Hughes	USA	AGM-65A Maverick	ASM		
	IEI/Hughes	USA	BGM-71A TOW	ATM		
8 Israel	IAI Ramta	USA	Dabur class	CPB	Cann MG ShSh	
	..	USA	Flagstaff-2	Hydrofoil FPB	ShSh MG	USA
10 Korea, North	Mayand Do	China	Romeo class	Sub		
	..	USSR	MiG-21MF	Fighter		
10 Korea, South	..	Italy	Fiat-6614	APC		
	Hanjin	USA	Hughes-500MD	Hel	ATM	USA
	Tacoma Korea	USA	PSMM-5	FPB		

Year of licence	Year in production	Current annual production rate	Total number planned	Total number produced	Programme cost	Unit cost	Comments
1971	1972	6	140	82	..	..	First 40 assembly only, then licence production of 100 from local raw material
1962	1975	30	219	120	..	..	
1977	..	..	..	..	..	..	
1970	1972	250	..	..	..	..	For licence-produced B-1 Jonga vehicle; French assistance 1971–73, then completely with local capacity
1973	1980	..	..	..	..	..	Local development from licence-built Gnat; first flight planned for 1979
1973	1976	5	100	20	..	2.5	Local development from licence-built Gnat; production run of 4 years expected; total requirement: 100; arms: 2 × Aden cannon
1972	1976	5	20	10	..	..	
1978	1979	..	150	..	2 392.8	9.0	
1965	1967	100	1 000	..	..	..	
1965	1973	..	6	4	..	..	
1976	1979	30	200	..	..	..	
1972	1973	5	150	150	..	..	
1972	..	30	..	..	..	..	
1977	..	..	30	..	..	..	
1975	1976	16	50	24	..	1.3	Some components are locally produced
1975	1972	3	60	18	..	..	New plant set up in 1976; assembly
1976	..	..	2 500	..	..	..	New company set up: 65% financed by Iran Electronics and 35% by BAC; production to start in Jun 1980; future of programme uncertain
1975	1980	..	50	..	650.0	..	Initial programme cost of $500 mn was modified in 1978 at $150 mn more in order to produce 50 Model 214A and 350 Model ST (stretched version); future of programme uncertain
1978	1980	..	350	..	650.0	..	Stretched version; factory to be ready in 1979 and will be handed over to Iran after 5 years
1978	..	..	5 000	..	..	..	Designation: Maverick; future of programme uncertain
1976	1978	..	1 000	..	..	..	Future of programme uncertain
1973	1976	10	33	33	..	..	12 delivery from USA, rest licence produced; production reportedly completed; replaced by Dvora class
1977	..	..	20	..	..	..	First delivery from USA, 10 licence produced; arms: Harpoon ShShM; weight: full-load
1973	1976	3	..	5	..	..	Continued programme; first 6 delivered from China
1974	..	..	..	..	..	..	First delivery was reportedly planned for 1978 but no information available
1976	1977	20	..	..	..	..	Not yet in production in Italy
1976	1978	..	66	..	..	..	First delivery of 34 from USA in 1976–77; by 1980 local manufacture of all components except P
1976	1977	..	..	..	..	..	

Region code/ Country	Manufacturer	Licenser	Weapon designation	Weapon description	Standard equipment	
					Type	Country
12 Libya	..	Italy	SF-260W Warrior	Fighter/COIN		
14 Mexico	..	Brazil	EMB-110	Transport		
	..	Brazil	EMB-326GB	Trainer/COIN		
	Vera/Salina CR	UK	Azteca class	PB	Cann	
13 Nigeria	..	FRG	Bo-105D	Hel		
9 Pakistan	Dhamial	France	SA-316B Alouette-3	Hel		
	..	FRG	Cobra-2000	ATM		
	L Kamra	Sweden	Saab-Supporter	Trainer/Ground attack		
	..	USA	Hughes-500C	Hel		
	Kiyuski	USA	T-41D	Trainer		
15 Peru	SIM Callao	Italy	Lupo class	Frigate	Cann Hel RL ShAM ShSh	Italy Italy Italy Italy France/Italy
	SIM Callao	Italy	Maestrale class	Frigate	Cann ShAM ShSh	Italy/ Sweden Italy France/Italy
	..	USSR	Mi-6	Hel		
10 Philippines	Marcelo Yard	Australia	DH-9209	CPB	MG	
	..	FRG		PB	Cann	
	PADC	UK	BN-2A Defender	Transport		
13 South Africa	Atlas	France	Mirage F-1C	Fighter		
	Austral Eng	France	Eland-2	AC		
	..	France	Cactus	Landmob SAM		
	Durban	Israel	Reshef class	FPB	Cann ShSh	 Israel
	Atlas	Italy	Impala-2	Trainer/COIN		
	Atlas	Italy	AM-3C Bosbok	Trainer		
10 Taiwan	..	Israel	Gabriel-2	ShShM		
	AIDC	USA	F-5E Tiger-2	Fighter	ASM Bomb	USA USA
	AIDC	USA	F-5F Tiger-2	Trainer		
	..	USA	AIM-9J	AAM		
	..	USA	AIM-9L	AAM		
	..	USA	MIM-23B Hawk	Landmob SAM		
	..	USA	PSMM-5	FPB	Cann Cann ShSh	Italy USA France/Italy

Year of licence	Year in production	Current annual production rate	Total number planned	Total number produced	Programme cost	Unit cost	Comments
1977	1980	..	120	..	..	..	
1978	..	..	..	..	..	..	
1978	..	..	..	..	..	..	
1975	1976	2	..	10	..	..	Designed to meet Mexican requirements; first 22 delivered from UK 1974–76
1977	1978	10	..	20	..	..	Final assembly only
1968	1972	12	..	..	..	..	
1963	1964	100	..	..	..	..	FRG government claims no licence production contract exists
1974	1978	..	25	..	..	..	Designation: MFI-17; first 45 delivered from Sweden; total number planned may be 100
1976	..	..	..	..	..	..	
1976	1980	..	..	..	..	..	Planned production rate: 50/year
1974	1979	1	2	..	..	..	2 more delivered from Italy; arms: 8 × ASPIDE/ Albatross ShAM, 4 × Otomat, 1 ASW hel
1977	1980	..	2		..	..	
1977	1977	6	6	..	..	..	
1975	..	24	80	49	..	..	
1977	..	..	14	..	..	..	
1974	..	6	100	20	..	..	Phase 1: 6 delivered from UK in 1974; phase 2: 14 delivered empty and unpainted; phase 3: assembly of 20 from kits; phase 4: local manufacture of 60
1971	..	..	100	..	..	..	
1963	..	100	1 000	..	..	..	Designation: Panhard AML-60/90; second generation locally developed; local P
1974	1977	100	..	..	..	..	
1974	1978	..	3	..	..	..	
1974	1974	30	100	90	..	..	Designation: MB-326 K; Rolls-Royce P
..	..	..	..	..	..	..	
1977	..	..	..	..	..	..	
1973	1974	48	187	139	..	..	Arms: USA okayed sale of Maverick AAM for production from 1979 onwards instead of selling more advanced aircraft
1976	1978	..	21	..	..	..	
1973	1974	6	1 046	..	..	..	
2000	..	..	..	..	..	..	
1975	1978	..	..	..	..	..	
1976	1978	..	15	1	..	..	Original order for 15 cancelled due to high costs; to be replaced by local design; arms: 4 × Otomat

3. World arms trade

Square-bracketed numbers, thus [1], refer to the list of references on page 187.

I. The trends

The international trade in arms is one of the greatest and most alarming components of the ever-increasing militarization of the world. In particular, the transfer of major weapons[1] from the industrialized countries to the so-called underdeveloped countries of the Third World[2] shows the most drastically rising trend.

During the early 1970s major weapon supplies to Third World countries rose steadily at a yearly average of 15 per cent. The past five years, 1974–78, show an average yearly increase of 25 per cent, as was predicted from the 1977 figures. Year-to-year figures are too erratic to measure the trend, since the numbers of weapons delivered can differ greatly from any 12-month period to another. A better *trend-measuring* device is to show the five-year moving averages, as is done in table 3.1 and 3.2 below.

Several factors explain the SIPRI total figures for 1978. During the past year, several large orders for major weapons which had been placed during previous years were delivered. Many of these deliveries were of the most expensive types of weapons, such as missiles and frigates.

A number of political events during the year contribute to the explanation of part of the increase for some regions: for example, the increase in US supplies to the Far East in connection with the withdrawal of US forces from South Korea and Taiwan; improved US relations with China; and, in Africa, the war between Somalia and Ethiopia and the inflamed situation in Southern Africa. Each of these factors has had its effect on the acquisition of new weapons in many countries in several regions (see page 182 below).

[1] The SIPRI data on transfers of major weapons include aircraft, armoured fighting vehicles, missiles and warships.

According to the SIPRI statistics, *major weapons* account for about 40 per cent of total arms sales. The remaining 60 per cent consists mostly of related equipment, electronics, support equipment, training, spares and so on, while the share of *small arms*, in value terms, is likely to account for no more than 25 per cent. In terms of volume, of course, the share accounted for by small arms is larger.

[2] The Third World regions employed by SIPRI (as well as the countries belonging to each region) are identified in the tables of world military expenditure, appendix 1A.

The SIPRI value for the international arms trade during the past 20-year period, 1959–78, is given in tables 3.1 and 3.2—aggregate tables of the values of imports of major weapons by Third World regions and of exports of major weapons by the major supplying countries.

For the United States, the US Defense Department announced in December 1978 that in real prices the value of total arms sales by the USA in FY 1978 reached a total of $13 300 million. Of this, $2 300 million was for sales to other NATO states [1–3].

According to various US sources, the overall value of world arms sales runs at about $20 000 million per year.[3] The Arms Control and Disarmament Agency (ACDA) gave the US share of the world total as 39 per cent in 1976, while other sources attribute over 50 per cent to the USA [6]. In the SIPRI statistics the US share of all deliveries in calendar year 1978 was 48 per cent world-wide, and 41 per cent of the total to the Third World.

Another main reason for the constant increase in the value of the international arms trade is, apart from the impact of inflation, also explained by the increased volume of *more sophisticated* weapons transferred. Relatively little surplus or second-hand equipment is nowadays traded since the buyers increasingly require more modern armaments.

This increase in weapon sophistication is markedly reflected in the costs. If one compares weapon prices in 1945 prices with current prices, then, on average, the price of a main battle tank, for example, has risen from $55 000 to $1 100 000. The price of transport vehicles has increased fivefold, and the price of a fighter aircraft has risen from $1 million in the 1950s to $3–4 million in the 1960s, and to $8 million in the 1970s. The next 'generation' of fighter aircraft will cost around $16–24 million without reference to any particular individual weapon.

A third factor with an impact on the increase of both the value and the volume of the international arms trade is the fact that the operational lifetime of the weapons tends increasingly to become shorter. The lifetime of a fighter aircraft, for example, is generally reckoned as 10 years, which means that fighter types for the 1990s are already at the design stage.

In 1978 the share of total major weapon imports for Third World countries was 70 per cent, as compared with 30 per cent for the industrialized countries. As can be expected, many countries in the industrialized world are more than 50 per cent self-sufficient in their arms procurement, so their requirement for imports is therefore much less.

[3] See, for example, reference [4]: " . . . the U.S. accounts for more than one-half of $20 billion in world arms sales . . . "; and reference [5], for a figure of more than $22 000 million.

Table 3.1. Values of imports of major weapons by the Third World: by region, 1959–78[a]

The figures are SIPRI estimates, as expressed in US $ million, at constant (1975) prices.
A = yearly figures, B = five-year moving averages.

Region code	Region[b]		1959	1960	1961	1962	1963	1964	1965	1966
8	Middle East	A	311	161	196	574	393	388	441	440
		B[c]	277	314	327	342	398	447	545	718
10	Far East (excl	A	518	762	200	356	310	392	340	497
	Viet Nam)[d]	B	483	499	429	404	320	379	348	339
15	South America	A	59	181	205	109	72	51	110	138
		B	154	146	125	124	109	96	100	127
12	North Africa	A	8	12	15	39	34	40	81	122
		B	9	16	22	28	42	63	82	92
9	South Asia	A	194	268	289	189	221	79	213	391
		B	344	316	232	209	198	219	235	250
13	Sub-Saharan Africa	A	60	36	56	47	47	68	95	93
	(excl S. Africa)	B	32	41	49	51	63	70	77	78
	South Africa	A	22	5	4	16	155	51	186	92
		B	17	14	40	46	82	100	112	90
14	Central America	A	19	58	211	298	96	34	18	21
		B	62	120	136	139	131	93	37	19
11	Oceania	A	–	–	–	–	–	–	–	–
		B	–	–	–	–	–	–	–	–
	Total (excl Viet Nam)[d]	A	**1 191**	**1 484**	**1 177**	**1 628**	**1 328**	**1 104**	**1 485**	**1 794**
		B	**1 378**	**1 466**	**1 362**	**1 344**	**1 344**	**1 468**	**1 536**	**1 715**
	Viet Nam	A	12	31	74	75	56	91	74	237
		B	38	51	50	65	74	107	190	274
	Total[e]	A	**1 203**	**1 515**	**1 251**	**1 703**	**1 384**	**1 195**	**1 559**	**2 031**
		B	**1 416**	**1 516**	**1 411**	**1 409**	**1 418**	**1 574**	**1 726**	**1 989**

[a] The values include licensed production of major weapons in Third World countries (see appendix 3C, page 242). For the values for the period 1950–56, see *SIPRI Yearbook 1976*, pp. 250–51; and for 1957–58, *SIPRI Yearbook 1978*, pp. 254–55.
[b] The regions are listed in rank order according to their average values for 1970–78. The region code numbers in the first column correspond to those used in the arms production and trade registers (appendices 2A, 2B, 3A and 3B).
[c] Five-year moving averages are calculated from the year arms imports began, as a more stable measure of the trend in arms imports than the often erratic year-to-year figures.
[d] Viet Nam is included in the figures for the Far East after 1975, the year the Viet Nam War ended.
[e] Items may not add up to totals due to rounding. Figures are rounded to the nearest 10.
– Nil

Source: SIPRI computer-stored data base. Information on individual countries and arms transactions will be made available on request.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1 063	1 258	1 212	1 462	1 758	1 076	2 211	2 836	3 527	3 164	4 667	6 583
883	1 087	1 351	1 353	1 544	1 869	2 282	2 653	3 371	4 155	–	–
199	266	586	271	419	162	302	249	640	1 035	482	2 366
378	364	348	341	348	281	354	478	542	954	–	–
128	208	158	148	222	310	352	446	630	710	804	1 069
148	156	173	209	238	296	392	490	588	732	–	–
135	83	87	121	123	167	145	228	761	929	658	1 158
102	110	110	116	129	157	285	444	544	747	–	–
271	297	312	300	499	409	289	373	177	414	571	1 019
297	314	336	363	362	374	349	332	365	511	–	–
81	55	71	121	134	89	152	386	232	432	574	1 230
79	84	92	94	113	176	199	258	355	571	–	–
78	45	46	77	69	25	37	274	179	118	290	330
89	68	63	52	51	96	117	127	180	238	–	–
16	8	10	6	47	35	56	87	137	58	114	192
15	12	17	21	31	46	72	75	90	118	–	–
–	–	–	–	–	–	–	–	–	3	2	–
–	–	–	–	–	–	–	–	–	–	–	–
1 971	**2 220**	**2 482**	**2 506**	**3 272**	**2 273**	**3 545**	**4 878**	**6 284**	**7 312**	**8 163**	**13 948**
1 990	**2 195**	**2 490**	**2 551**	**2 816**	**3 295**	**4 050**	**4 858**	**6 036**	**8 158**	–	–
494	473	298	433	435	1 200	82	816	20	–	–	–
315	387	427	568	490	467	385	298	–	–	–	–
2 465	**2 693**	**2 780**	**2 939**	**3 707**	**3 473**	**3 627**	**5 064**	**6 304**	**7 312**	**8 163**	**13 948**
2 305	**2 582**	**2 917**	**3 118**	**3 305**	**3 762**	**4 435**	**5 156**	**6 094**	**8 158**	–	–

Table 3.2. Values of exports of major weapons to regions listed in table 3.1: by supplier, 1959–78[a]

The figures are SIPRI estimates, as expressed in US $ million, at constant (1975) prices.
A = yearly figures, B = five-year moving averages.

Country[b]		1959	1960	1961	1962	1963	1964	1965	1966
USA[c]	A	326	713	393	368	514	372	540	514
	B	476	459	463	472	437	462	484	533
USSR[c]	A	146	215	511	1 029	429	375	544	970
	B	293	432	466	512	578	669	773	910
UK	A	239	256	241	124	177	179	265	193
	B	288	266	207	195	197	188	203	227
France[c]	A	65	49	50	121	194	137	96	140
	B	85	91	96	110	120	138	127	146
China[c]	A	174	163	–	–	–	51	9	47
	B	128	128	67	43	12	21	25	26
Italy	A	*	9	–	1	20	20	7	1
	B	17	9	6	10	10	10	14	23
FR Germany	A	34	30	6	2	13	26	13	83
	B	17	16	17	15	12	27	28	27
Netherlands	A	6	1	3	3	*	11	22	1
	B	3	3	3	4	8	7	7	8
Canada[c]	A	88	14	22	3	13	11	18	12
	B	27	27	28	13	13	11	13	20
Czechoslovakia	A	76	59	6	6	16	9	4	8
	B	36	35	33	19	8	9	10	14
Sweden	A	*	1	1	*	–	–	–	2
	B	10	10	–	–	–	–	–	–
Switzerland	A	–	–	–	–	2	–	1	1
	B	–	–	–	–	1	1	1	1
Japan[c]	A	15	–	14	24	1	1	6	11
	B	15	16	11	8	9	9	10	19
Third World	A	2	4	2	10	4	3	4	25
	B	6	6	4	5	5	9	10	11
Other indus. West	A	–	2	3	2	1	*	30	23
	B	1	1	2	2	7	11	22	24
Other indus. East	A	32	*	–	11	*	–	*	–
	B	14	15	9	2	2	2	–	–
Total[d]	A	**1 203**	**1 515**	**1 251**	**1 703**	**1 384**	**1 195**	**1 559**	**2 301**
	B	**1 416**	**1 516**	**1 411**	**1 410**	**1 418**	**1 574**	**1 727**	**1 989**

[a] The values include licences sold to Third World countries for production of major weapons (see appendix 3C, page 242). For the values for the period 1950–56, see *SIPRI Yearbook 1976*, pp. 252–53; and for 1957–58, *SIPRI Yearbook 1978*, pp. 256–57.

[b] The countries are listed in rank order according to their average values for 1970–78.

[c] Including exports to Viet Nam.

[d] Items may not add up to totals due to rounding.

* <$0.5 million.

– Nil

Source: SIPRI computer-stored data base. Information on individual countries and arms transactions will be made available on request.

1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
481	754	1 244	1 258	1 179	1 166	1 061	1 404	2 343	3 892	3 425	5 800
707	850	983	1 120	1 182	1 214	1 431	1 973	2 425	3 368	–	–
1 545	1 116	834	1 136	1 515	1 225	1 537	1 930	2 160	1 554	2 173	4 020
1 002	1 120	1 229	1 615	1 249	1 469	1 673	1 681	1 871	2 367	–	–
203	294	348	185	393	369	316	579	647	587	680	660
261	245	285	318	322	368	461	500	562	631	–	–
68	288	172	203	276	351	538	449	593	553	1 245	2000
153	174	201	258	308	363	441	497	676	935	–	–
17	5	10	22	106	158	27	104	63	57	86	200
18	20	32	60	65	83	92	82	67	101	–	–
20	67	53	43	41	52	56	139	72	159	152	621
30	37	49	51	49	66	72	96	116	229	–	–
4	11	17	1	25	37	3	116	138	131	101	80
26	23	12	18	17	36	64	85	98	113	–	–
–	5	25	10	34	27	39	33	42	29	26	64
11	8	15	20	27	29	35	34	34	39	–	–
11	48	19	37	55	39	6	1	6	34	28	107
22	25	34	40	31	28	21	17	15	35	–	–
11	39	22	31	14	14	1	15	6	6	15	30
17	22	23	24	16	15	10	8	9	14	–	–
–	–	*	–	–	5	1	6	21	21	6	–
–	–	1	1	2	7	6	11	11	11	–	–
1	1	–	2	2	2	2	*	1	8	2	7
1	1	1	1	2	2	1	3	3	4	–	–
30	49	2	*	*	–	–	3	–	3	–	21
20	18	16	10	–	1	1	1	1	5	–	–
15	9	20	8	15	18	20	276	185	202	60	203
15	15	13	14	16	67	103	140	149	185	–	–
58	7	11	3	46	11	19	11	13	46	141	105
26	20	25	16	18	18	20	20	46	63	–	–
2	–	2	–	5	–	–	–	2	30	22	7
1	1	2	1	1	1	1	6	11	–	–	–
2 465	**2 693**	**2 780**	**2 939**	**3 707**	**3 473**	**3 627**	**5 064**	**6 304**	**7 312**	**8 163**	**13 948**
2 305	**2 581**	**2 917**	**3 118**	**3 305**	**3 762**	**4 435**	**5 156**	**6 094**	**8 158**	–	–

The terms of arms transfer deals also differ markedly between the developed and the underdeveloped countries. The former mostly conclude compensation or offset agreements among themselves, often involving large sections of their industries. The underdeveloped countries, on the other hand, normally conclude various credit arrangements. Some Third World countries, such as Libya and Saudi Arabia, pay cash. Military aid, gifts and grants play an ever smaller role in the overall pattern of transfer arrangements.

II. Control of the arms trade

During 1977 and 1978, the issue of the arms trade received more attention, relatively speaking, than has normally been the case. A debate of sorts has been started, the main reasons being (*a*) the unprecedented rise in transfers of highly sophisticated weapons to the Middle East, in particular to Iran and Saudi Arabia, (*b*) the initiative taken by the Carter Administration in the United States to limit its arms sales (see page 177 below), and, to a certain extent, (*c*) the initiation of bilateral talks between the USA and the USSR.

These US–Soviet talks on possible limitations on arms transfers began at a meeting in 1977 in Helsinki and continued during 1978. The content and results of these talks are, however, unknown, except for various unconfirmed speculations.

Renewed interest in the issue has also been noted on the part of various European parliaments and governments.

III. Third World purchases of major weapons

The flow

Tables 3.1 and 3.2 show the general pattern of the flow of arms transfers to Third World countries, both by importing region and by exporter. Further breakdowns are detailed in table 3.3 (the rank order of major weapon exporters) and in table 3.5 (the rank order of importing regions, by major importing nations; see page 183). Table 3.4 shows the number of orders for weapons concluded world-wide during 1976–78 by the eight largest exports and by four weapon categories, illustrating also the *types* of weapon exports which are prevalent.

Table 3.3. Rank order of all major weapon exporters in 1978[a]

Exporting country	SIPRI value of exports (1975 $ million)	Percentage of world total exports
USA	9 654	47
USSR	5 412	27
France	2 228	11
Italy	795	4
UK	755	4
FR Germany	442	2
China	214	1
Israel	155	0.8
Canada	107	0.5
Australia	106	0.5
South Africa	89	0.4
Brazil	80	0.4
Netherlands	64	0.3
Egypt	58	0.3
Finland	54	0.3
Czechoslovakia	52	0.3
Japan	21	0.1
Singapore	21	0.1
Spain	20	0.1
Norway	19	0.09
Switzerland	14	0.07
Cuba	6	0.03
Austria	4	0.02
North Korea	4	0.02
Yugoslavia	4	0.02
Romania	3	0.02
Libya	1	0.005
Morocco	1	0.005
New Zealand	0.5	0.003
World total	**19 971**	

[a] The SIPRI values shown in this table do not correspond to the aggregate export table (table 3.2) since the values of exports to industrialized countries are included in this table.

Table 3.3 reflects only the *deliveries* in 1978 and not the volume of current orders pending. Further, it is shown only for the purpose of illustrating the pattern of exports and not as a basis for any long-range extrapolations.

Source: SIPRI computer-stored data base.

The suppliers

Not surprisingly, the leading world arms *suppliers* are in principle identical to the list of leading arms *producers*.

The significant groups of supplier countries remain clearly distinctive (see table 3.2): the first prominent group is the two dominant suppliers, the USA and the USSR, and the second comprises the major European weapon exporters France and the UK. France's position as the third largest exporter in the world was confirmed in 1978, in particular when the past five years are used as the basis.

The third group of suppliers exhibit more changes over time; many

Table 3.4. Numbers of export sales orders for major weapons to the Third World from the eight main exporting countries, by weapon category, 1976–78

Exporting country	Aircraft orders	Armoured vehicle orders	Missile orders	Warship orders
USA	195	30	114	29
USSR	52	34	58	12
France	71	10	51	24
Italy	36	4	8	6
UK	44	12	11	16
FR Germany	11	10	6	21
China	4	3	3	4
Israel	6	–	4	1

European countries are increasing their arms exports in competition with the leading suppliers, notably Italy and FR Germany. China is now also included in this group. (If other than only the major-weapon category of armaments were also included in the statistics, this group would include Belgium, Sweden and Switzerland, all of which export small arms.)

One country alone, Japan, stands out as atypical since it possesses a large and expanding armaments industry but shows no significant increase in arms exports.

There are, of course, other fundamental differences between the major arms suppliers than the mere volume of sales. First the *type* of weapons supplied differs: the largest share of exports by the biggest suppliers is combat aircraft and missiles. FR Germany exports primarily fast missile-equipped patrol boats and helicopters. Spain and Sweden export trainer aircraft, and so on. Most of this equipment is new. China exports all four weapon categories, but nearly always refurbished or second-hand weapons.

Israel's position in the list in table 3.3 reflects the huge investments made in local defence industries, which has led to the achievement of an arms-production capacity. This in turn creates the need to export in order to cover part of the costs. South Africa and Brazil have followed the same line of development.

The second type of fundamental difference between the major arms suppliers is that the number of customers varies markedly. Western suppliers deal with a large number of buyers in the Third World, while the Soviet Union and China tend to concentrate on certain countries and regions during certain periods. For example, the largest volume of Soviet arms sales during 1977 and 1978 have been to Africa (Algeria, Angola, Ethiopia, Congo, Equatorial Guinea, Madagascar, Mozambique, Malawi, Somalia and Tanzania), to Latin America (Cuba and Peru) and to India. The share of the Warsaw Treaty Organization (WTO) states in this particular period is relatively small (21 orders of a total of 161). Chinese sales for the period have been to Pakistan (12), Democratic Kampuchea (7), Zaire (4), Albania (2), North Korea (2), Romania (2), Bangladesh (1), Cameroon (1), Guinea (1) and Tunisia (1).

The fourth supplier group visible in table 3.2, the Third World suppliers, is a group that can be expected to rise further in the future. It consists of those underdeveloped countries which have concentrated on importing arms technology in addition to weapons, and, with the growth of their local arms industries, they have been able to appear as exporters on the world market. (Many countries listed in the first three groups have gone through similar development phases, for example, the European countries, Japan and China.)

The United States

The Middle East has for the past five-year period received 70 per cent of all US exports to the Third World. Israel has moved from its mid-1970s position as the largest importer from the United States, and Iran has stood out as the single largest purchaser of US weapons, not only in the Middle East region but in the world as a whole. But in 1978 Saudi Arabia actually surpassed Iran as the largest importer of US weapons, according to the value of new orders.

The Far East provides the second largest market for the USA (South Korea, Taiwan and Indonesia).

The third largest purchasing area is Europe, with Spain as the single largest buyer.

Latin America is no longer among the largest markets for US weapons, due to a long-standing US embargo policy. Several countries in the region have been refused sophisticated armaments on the grounds that the régimes there violate human rights. Mexico and Guatemala have, for example, unsuccessfully requested permission to buy the F-5E Tiger-2 fighter. (Mexico withdrew its request for weapons before any official US veto was passed.)

Traditionally the United States is not among the major arms suppliers to Africa, but their involvement in the region has been on the increase since 1974. Before the break in relations with Ethiopia, this country was the largest recipient of US military aid in Africa. In FY 1977, 62 per cent of Foreign Military Sales (FMS) to Africa went to Sudan, 24 per cent to Morocco and 14 per cent was shared among Ethiopia, Zaire, Kenya and Nigeria [7].

US arms sales policy.[4] In May 1977 President Carter issued an Executive Policy Statement in which he said, "Because of the threat to world peace embodied in this spiralling arms traffic, and because of the special responsibility we bear as the largest arms seller, I believe that the United States must take steps to restrain its arms transfers" [1].

The Carter policy on arms sales contains the following restrictions: (*a*) a ceiling established for each fiscal year on governmental arms exports to non-allied nations; (*b*) a control on the first introduction of certain advanced systems into an area; (*c*) a prohibition on advanced systems for export only; (*d*) a prohibition on various types of co-production arrangements; (*e*) tighter control on re-transfers; and (*f*) special controls on sales promotions (see also page 179).

In addition to these stipulations, the Carter Administration has reconfirmed the previous policy of not selling arms to régimes which violate human rights.

The Carter Administration claims that a reduction in FMS arms sales of 8 per cent (figures in constant FY 1976 dollars), from $9 300 million in FY 1977 to $8 600 million in FY 1978, was actually achieved [10], representing a reduction of $700 million. This calculation has already been questioned internally in the USA, in particular by the General Accounting Office (GAO) which, in a special study published in April 1978 [11], claimed that the actual reduction from FY 1977 sales was only $66 million rather than $700 million. The error was due to inconsistencies and accounting errors which resulted in a substantial overstatement of FY 1977 sales, which meant that the President quoted erroneous sales figures as a basis for establishing the arms sales ceiling for FY 1978. Had a 7.5 per cent reduction been applied to the correct sales figures, the FY 1978 ceiling would have been $584 million lower.

The eventual effects of the Carter policy have further to be considered in relation to the exemptions to the regulations: first, 14 NATO states, Japan, Australia, New Zealand, and in principle also Israel and the member states of the OAS (apart from restrictions on certain types of weapons), are not subject to export restrictions. This leaves 51 countries subject to restrictions and, of these, 10 are in the Middle East. Secondly, company commercial sales are not covered; and thirdly, the transfers of military 'software' such as training, construction work and technical assistance, are not covered. This obviously means that considerable amounts of military equipment can still be transferred with no control. According to ACDA, the sale of military construction, training and administrative services absorbed 34 per cent of the total value of US arms sales in FY 1976. Further, the Defense Department

[4] Numerous analyses of the so-called Carter policy and its effects have already been published. See, for example, references [8, 9].

estimates that 60 per cent of all FMS sales are for support articles and services [1].

Bearing all this in mind, it is still possible to see a number of effects of the Carter policy. The ceiling has resulted in the refusal of weapon requests from 67 countries, deals worth $1 800 million in FY 1977 according to the US State Department [12] and $1 000 million in FY 1978.

The ceiling for FY 1979 is $8 430 million—a reduction of 8 per cent (or $733 million) from FY 1978—as announced in May 1978. However, certain manipulations can of course influence the eventual ceilings achieved during a fiscal year; for example, the decision by Iran in late 1978 to defer arms purchases worth $1 000 million to 1979.

The US control on first introduction of a weapon system into a given area has been applied on a few occasions, notably to stop the sales of the advanced F-16 fighter to South Korea and Taiwan. Also, Iran and Taiwan were also denied the F-4G version of the Phantom fighter known as Wild Weasel. Sweden was not permitted to sell its Viggen (with US engine) to India on the grounds that the plane would have represented the introduction of an advanced weapon system into a new region.

The prohibition of advanced weapon systems for export only will probably apply, for example, to Northrop's land-based version of the F-18 Hornet, called the F-18L Cobra, which is under development to meet a specific Iranian request.

The control on retransfers has been applied on a number of occasions, for example, to stop the Italian G-222 military transport plane from being delivered to Libya. The G-111 also has a US engine. (Aeritalia has begun to re-engine the G-222 to circumvent the US embargo on Libya.)

There is at present no detailed information on how the controls on sales promotions are applied. The measure was obviously taken as a result of the past few years' revelations on large bribes, the so-called Lockheed scandal.

The critics of the Carter policy may have solid arguments and the loopholes left uncovered have been described above. But it is premature to make a firm judgement of this policy, first announced in 1976, considering the magnitude of the task of reducing arms sales.

Furthermore, one important component is the fact that the US Administration has declared on several occasions that the policy will not be continued indefinitely unless the other major arms exporting nations also adhere to it. This means that the governments of the NATO states are meant to abide by a restrictive policy, while they are main competitors on the arms market. It also obviously means that the same kind of joint policy in respect to arms exports must be negotiated with the Soviet Union. In this respect, the fact that bilateral talks are for the first time being held on the issue of arms exports in general may in future yield results. (Bilateral talks on restrictions of arms sales have been held before, for example, concerning the Middle East, but the current discussions apparently concern the principal issue of the spread of conventional armaments.)

The Soviet Union

The USSR is the second largest individual arms supplier in the world. According to US estimates, it accounted for 30–40 per cent of total world arms exports in 1976 [13]. The same source states that weapon sales have become a significant part of overall Soviet exports, accounting for just over 10 per cent of the total in 1976. The US Central Intelligence Agency (CIA) estimates that, without arms sales, the Soviet Union would have a $1 200 million trade deficit with the Third World.

It is impossible to verify the accuracy of this information and there are no official Soviet statistics to confirm or deny it. The SIPRI figures arrive at a Soviet share of 27 per cent in 1978 (see table 3.3). A large fraction of Soviet exports in the past three years has gone to Angola and Mozambique, and, in particular in 1978, the impact of the war between Somalia and Ethiopia is clearly visible in the SIPRI statistics for the Soviet Union.

Other suppliers

Whereas the Soviet Union and the United States are at least discussing the issue of arms sales, the governments of the major European exporting countries have so far shown no indication that they might reconsider their present policies.

The UK is reconsidering its arms sales policies in the wake of the fact that it has been surpassed by France. The official British arms sales promotion office, International Military Services, resorted in 1978 to dispatching a floating exhibition of British arms: a 15 000-ton Royal Fleet Auxiliary vessel with British military hardware on board, including Scorpion tanks, guided missiles and fast patrol boats, left the UK in September 1978 for an extensive defence sales cruise to the Mediterranean, Africa and South America.

British arms export in real prices are currently quoted as $1 728 million per year [14].

France, which today occupies the position of third largest arms exporter in the world, adheres to its traditionally pragmatic policy of selling as much as possible, wherever possible. The fact that the French government accepted the UN mandatory embargo on arms sales to South Africa resulted in the cancellation of two A-69 frigates and 'Agosta'-class submarines. But France has not revoked its licence contract with South Africa for armoured cars and the Mirage F-1 fighter, as well as the Cactus surface-to-air missile.

According to figures released in March 1978, French arms exports increased by almost 50 per cent in 1977, to $5 300 million [15]. Two-thirds of this total consisted of military aircraft, helicopters and missiles.

However, President Giscard d'Estaing has questioned the French arms sales policy in a parliamentary debate in February 1978, saying that French aerospace capacity could be better utilized for non-military purposes [16].

FR Germany is rising rapidly among the ranks of major arms exporters in spite of the fact that the government emphasizes its restrictive policy. In particular, the German shipbuilding industry is conquering new markets. Several Latin American countries are purchasing Type 209 submarines and West German fast patrol boats are on order in a large number of other Third World countries. The establishment of the Euromissile organization for joint production with France has also enhanced West German arms sales. The Euromissile office in Paris is officially responsible for the sales policy. According to the German government, France is thus politically solely responsible for arms deals concluded with Middle Eastern and African countries. Syria is purchasing large numbers of the Euromissile HOT and Milan anti-tank missiles, and will also buy the AS-34 Kormoran air-to-surface missile. But financially the Euromissile sales are divided between France and FR Germany: Aérospatiale will be paid $106 million and Messerschmidt Bölkow Blohm will receive $90 million for the HOT and Milan deals with Syria, respectively.

FR Germany is presently debating its arms sales policy, at both governmental and parliamentary levels, but the industrial interest in promoting export sales is so far prevailing in practice if not in theory.

In *Italy*, arms sales have not received any marked public interest although there are reports of efforts within the parliament to review Italian export laws. This is also the case in *Sweden*.

Israel is a new arms-producer and -exporter. There are no public Israeli sources showing complete trade statistics, but it is reported that in the 1960s Israel exported only small arms, at a value of $60 million per year, which has been increased sixfold since then and now runs at $400 million in 1978. Major arms exported by Israel are the Gabriel ship-to-ship missile system and the 'Reshef'-class fast patrol boat, as well as the Kfir-C2 fighter.

Israel has experienced the difficulties of any new producer competing with established producers, in particular concerning the Kfir sales. Kfir has a US engine and the USA could therefore veto a proposed sale to Ecuador. When Israel attempted to acquire a US licence for production of the F-16A fighter, this was vetoed by the USA, reportedly not so much for political as for industrial reasons: the Israeli-built plane could have become a serious competitor on the world market to the US original version.

The Israeli Uzi machine-gun is sold to more than 60 countries, including the USA and other NATO countries. Other buyers are Nicaragua, Honduras, El Salvador and Mexico.

If one examines the political blocs rather than individual exporting countries, the international arms trade is very much a Western affair: *NATO* is responsible for 70 per cent of the world total, according to SIPRI statistics, and the *WTO* for 27 per cent.

Moreover, governments rather than private agents or even individual industries are responsible for the trade, since governments in all countries possess the political power over the control instruments, normally the granting of export licences.

One of the most well-known private arms sellers, Samuel Cummings of Interarms, has summarized his view of government arms sales policies in a rather pointed statement: "If I ever tried to sell arms the way governments sell arms, I'd end up in a jail forever" [17].

The Third World recipients

The rank order of arms recipient regions in 1978 is shown in table 3.5, which also shows the five largest importers, by region, together with their respective shares of the region's total.

The *Middle East* remains the world's largest arms-importing region, but the positions of the individual countries within this region keep shifting.

Iraq for the first time occupies the first place, due to large deliveries from the Soviet Union and France.

The change of régime in Iran will probably drastically change the pattern of arms imports to that country. By the end of 1978, there were already reports that most, if not all, of the large pending arms orders will be cancelled by the Moslem government, for example, as expressed in the following report: "The crisis in Iran could have disastrous consequences for Britain's flourishing arms export industry, which for the past few years has prized the Shah as the biggest single customer . . . in all, Iran, together with Saudi Arabia, has accounted for about 60 per cent of Britain's arms export business" [18].

Table 3.5. Rank order of Third World importing regions and major importing countries, 1978

Importing region	SIPRI value of imports (1975 $ million)	Percentage of Third World total	Five largest recipient countries	SIPRI value of imports (1975 $ million)	Percentage of region's total
Middle East	6 583	47	Iraq	1 423	22
			Iran	1 393	21
			Israel	1 377	21
			Saudi Arabia	1 081	16
			Syria	626	10
Far East	2 366	17	S. Korea	1 357	57
			Viet Nam	262	11
			Taiwan	209	9
			Thailand	129	5
			Indonesia	74	3
Sub-Saharan Africa	1 600	12	Ethiopia	365	23
			S. Africa	330	21
			Sudan	160	10
			Rhodesia	92	6
			Nigeria	91	6
North Africa	1 158	8	Libya	694	60
			Algeria	223	19
			Morocco	213	18
			Tunisia	29	3
South America	1 069	8	Brazil	371	35
			Argentina	265	25
			Peru	152	14
			Venezuela	151	14
			Ecuador	68	6
South Asia	1 019	7	India	750	74
			Pakistan	118	12
			Afghanistan	77	8
			Bangladesh	73	7
			Sri Lanka	2	0.2
Central America	192	1.3	Cuba	98	51
			Bahamas	48	25
			Mexico	20	10
			El Salvador	8	4
			Panama	6	3
Total Third World imports	**13 948**				

Even before his fall from power, the Shah of Iran was actually forced to revise new arms orders, for financial reasons. In 1977 Iran placed arms orders with the USA worth $5 400 million, and in 1978 for $2 600 million. Orders planned for 1979 had been reduced to $1 000 million [19].

Unofficial reports from the UK claim that the British industry hopes to resell arms ordered by Iran to China, in particular the 1 200 Chieftain tanks known as Shir Iran-2, specially developed to meet Iranian requests. These tanks should have been delivered to Iran from 1980 onwards.

In January 1979 the new Iranian régime announced a review of all arms contracts concluded since 1972. Plans for the establishment of local arms industries, for example, for the production of the British Rapier missile, have been suspended.

Egypt and Israel, which during the 1960s were the dominant arms importers, are currently not so prominent and, if peace efforts succeed, this can be assumed to have a certain effect on future arms procurement. In the case of Egypt, the huge investments in the Arab Military Industry, financed by Saudi Arabia, Qatar and the sheikdoms, will in future show up in the statistics. The main orders for licence production have gone to the UK and France.

The *Far East* pattern of arms imports reflects first of all the effect of the US forces leaving South Korea, coupled with a policy of transferring the majority of the armaments to the Korean forces. The USA has also decided to increase arms supplies to Taiwan as compensation for rapprochement with China. These supplies, however, are limited as regards sophistication—long-range aircraft with electronic intelligence equipment have been refused Taiwan. Arms deliveries to Taiwan will amount to $800 million up to 1983, according to the US Defense Department. Taiwan will be allowed to buy 44 F-5E fighters with Sidewinder missiles, and also the improved Hawk surface-to-air missile [20].

Indonesia and Malaysia, both experiencing internal guerrilla wars, are increasing their arms purchases from the West.

Another major political conflict in 1978 is also reflected in the Far East patterns of arms imports: the conflicts with Democratic Kampuchea and China have brought Viet Nam back into the arms trade statistics, for the first time since the end of the Indo China War in 1975. Arms deliveries from the Soviet Union included artillery, vehicles and various types of missiles. China withdrew its aid from Viet Nam in July 1978, and instead supplied Kampuchea with a radar defence network, aircraft and artillery. Reportedly, the Chinese aid allowed Kampuchea to increase its army from three divisions of about 5 000 men to 20 divisions.

Sub-Saharan Africa, during the 1960s described as the region with the lowest profile as regards militarization, is now the third largest arms-importing region. Considering the remaining unsolved conflicts and the situation in Southern Africa, this trend has been expected since the fall of the Portuguese colonial régime in 1974. In 1978 the greatest impact related to arms imports resulted from the war between Somalia and Ethiopia. Ethiopia accounted for 23 per cent of all major arms to

Africa and all were acquired from the Soviet Union. Soviet arms shipments to Ethiopia began in the spring of 1977 and reached a peak with the massive airlift in December 1977-January 1978. In addition to the weapons listed in the arms trade register (appendix 3B) the Soviet Union reportedly delivered more than 300 guns, numerous mortars, several batteries of rocket-launchers, and large quantities of ammunition and spares.

Somalia possessed some 400 aged Soviet T-34 and T-54/55 tanks before the war started, and a number of SA-2 surface-to-air missiles. Iran, Saudi Arabia and Egypt were reported to provide some military aid to Somalia, including 60 ex-French tanks. But on the whole, Somalia failed to receive military support from any of the Western powers. After the end of the war, discussions were reopened with the USA, concerning the future supply of weapons.

In *North Africa* Libya retains its position as the dominant arms importer, and also re-exports major arms as military aid to Uganda and Syria.

In *South America* the two leading arms producers, Brazil and Argentina, also dominate arms imports to the region, together accounting for 60 per cent of the regional total.

South Asia shows India as the sole dominant arms importer. A large part of the Indian total is made up of licensed production of the Soviet MiG-21 fighters and missiles. But India also imports heavy arms from the UK and France.

In *Central America* the delivery of MiG-27 fighters (a MiG-23 version which is capable of carrying nuclear weapons) to Cuba was the single most publicized arms import during the year. Both the Cuban and the Soviet governments declared that the planes did not carry nuclear missiles.

IV. Industrialized world purchases of major weapons

The rank order of arms importers in the industrialized world in 1978 is shown in table 3.6.

The industrialized world's share of total world arms imports was 30 per cent in 1978, as broken down in table 3.6. Some entries are exceptional; for example, Finland's position in 1978 is due only to the deliveries of new Soviet aircraft and missiles, and it can be assumed that Finland would not occupy the same position in a long-term series.

The largest arms producers and exporters are positioned low on the list, as could be expected. The USA traditionally imports very little military equipment.

Discussions are currently being conducted on a 'two-way' arms business

Table 3.6. Rank order of industrialized world arms importers, 1978

Importing country	SIPRI values of imports (1975 $ million)	Percentage of world total	Percentage of industrialized world total
Finland	998	5	15
Japan	790	4	12
Italy	757	4	12
Greece	639	3	10
Spain	547	3	8
Turkey	509	3	8
Netherlands	436	2	7
Australia	366	2	6
FR Germany	295	1	5
Denmark	164	1	3
UK	147	1	2
Czechoslovakia	142	1	2
Yugoslavia	102	0.5	2
Belgium	94	0.5	1.5
Bulgaria	70	0.4	1.1
German DR	65	0.3	1.0
USSR	54	0.3	1.0
Romania	53	0.3	1.0
Canada	47	0.2	0.7
Portugal	44	0.2	0.7
Austria	33	0.2	0.7
Switzerland	26	0.1	0.4
Poland	19	0.1	0.4
Sweden	19	0.1	0.4
USA	13	0.1	0.4
France	2	0.01	0.03
Norway	2	0.01	0.03
Hungary	2	0.01	0.03
Malta	1	–	–
World total	**19 971**		
Industrialized world total	**6 444**	33.33	

Source: SIPRI computer-stored data base.

between the United States and NATO, in order to secure the NATO standardization of weapons in the national armed forces. The United States has purchased the British Harrier fighter and the Euromissile Roland-2 SAM system, both for licensed production.

The figure for the Soviet Union is due solely to the import of tanker ships from Finland.

The positions of Japan and Italy are mainly explained by extensive licensed production of US aircraft and missiles.

China, which does not appear in the table, is soon to reach similar arms-importer status. Orders for French missiles were concluded in 1978 and the expected order for 70 British Harrier fighters was finalized in February 1979. France has agreed in principle to sell arms worth $350 million to China.

The Paris-based Coordinating Committee on Export Controls (Cocom) representing NATO and Japan, which controls the sales of military equipment to socialist states, met in November 1978 for the first time in three years in order to discuss arms exports to China. With the opening to the West of the Chinese market, all major members are seeking relaxations from Cocom's export restrictions comprising some 200 items. According to Cocom sources, Japan is seeking relaxation on 53 items out of 150 Japanese-made products. The United States and Britain have asked for permission to export more than 50 items each, but demand tighter controls on some types of defence-related equipment, on the other hand. FR Germany and France are seeking relaxation on more than 15 items each.

The future Cocom policy towards China will be finalized in June 1979. A consensus is already emerging, according to informal sources, that the original criteria of the early 1950s for imposing embargoes are now obsolete.

Considering the obvious attention paid by the Chinese delegations to practically all major arms producers in Europe in 1978 and considering several reports in early 1979 about official Chinese declarations on the need for modern armaments, it can be assumed that China for the next few years will show no interest in general restrictions on arms sales by the main producers.

References

1. *Newsletter*, Weapons for the World, Update II, CEP Publication N8-9, 18 December 1978, Council on Economic Priorities (New York).
2. *Foreign Military Sales and Military Assistance Facts, December 1978* (US Department of Defense, Data Management Division, Comptroller, DSAA).
3. *USA Document*, 'US meets first-year goal in reducing foreign arms sales' (Embassy of the United States of America, Stockholm, Sweden, 3 October 1978).
4. *Conventional Arms Transfer Policy, Background Information* (US Government Printing Office, Washington, D.C., 1978), p. 5.
5. Gervasi, T., *Arsenal of Democracy* (Grove Press, New York, 1977).
6. *World Military Expenditures and Arms Transfers 1967–1976* (ACDA, Washington, D.C., July 1978), p. 10.
7. *Report by the US General Accounting Office, Military Sales—An Increasing US Role in Africa*, ID-77-61, 4 April 1978.
8. *Implications of President Carter's Conventional Arms Transfer Policy* (Congressional Research Service, Library of Congress, Washington, D.C., 22 September 1977).
9. Klare, M. T. and Holland, M., *Conventional Arms Restraint: An Unfulfilled Promise* (Institute for Policy Studies, Washington, D.C., 1978).

10. *Government Business Worldwide Reports*, 15 May 1978 (Washington, D.C.).
11. *Report by the Comptroller General of the United States*, GAO, FGMSD-78-30, 12 April 1978.
12. *Aviation Advisory Services Newsletter*, August 1978.
13. 'Soviet weapons exports: Russian Roulette in the Third World', *Defense Monitor*, Vol. 8, No. 1, January 1979.
14. *Aviation Advisory Services Newsletter*, July 1978.
15. *Air International*, May 1978, p. 211.
16. *Air et Cosmos*, 18 February 1978.
17. *New Statesman*, 30 June 1978.
18. Stanhope, H., 'Growing concern over stability of Gulf and fate of British arms exports as Iran teeters on brink', *Times*, 7 November 1978.
19. *Air et Cosmos*, 28 October 1978.
20. *International Herald Tribune*, 23 December 1978.

Appendix 3A

Register of the arms trade with industrialized countries, 1978

For sources and methods, see appendix 3C. For conventions, see page 252.

Notes:

The key to the *region code* is given in the conventions, page 255.
Both the *recipient* and the *supplier* countries are listed in alphabetical order.
The *weapons* are listed in the following order: aircraft, armoured vehicles, missiles and warships.
The key to abbreviations in the *weapon description* column is given in appendix 3C, page 253.

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
7 Austria	Italy	24	Agusta	AB-212	Hel
	USA	50	Chrysler Corp.	M-60-A3	MBT
11 Australia	France	7	Dassault	Mirage-3E	Fighter-bomber
		1	DTCN	Durance class	Fleet repl
	FR Germany	2	Krauss-Maffei	Leopard	ARV
		76	Krauss-Maffei	Leopard-1-A1	MBT
		90	Krauss-Maffei	Leopard-1-A3	MBT
	UK	100	BAC	Rapier	Landmob SAM
		1	..	PCF-420	PB
	USA	2	Boeing	Boeing 707-320C	Transport
		12	Lockheed	C-130H Hercules	Transport
		..	MDD	F-15A Eagle	Fighter/interc
		10	Lockheed	P-3C Update-2	Fighter/ASW
		16	Grumman	S-2G Tracker	Fighter/ASW
		(90)	MDD	RGM-84A Harpoon	ShShM
		(72)	Raytheon	Seasparrow	ShAM/ShShM
		3	..	FFG-7 class	Frigate
4 Belgium	France	17	Sabca	Alpha Jet	Trainer

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
25.0	..	1978	1978	12	
			1979	12	
47.0	..	1978			
..	..	1977	1978	7	Final order Jul 1977
..	..	1977	1982	1	
..	..	1978	1978	2	Total number on order: 103
..	1.0	1975	1976	20	
			1977	30	
			1978	26	
..	..	1975	1976	18	
			1977	18	
			1978	37	
46.0	..	1975	1978	25	20 systems on order, including 10 Blindfire radars
			1979	25	
			1980	25	
			1981	25	
..	..	1977			14 more to be licence produced
16.9	..	1978	1978	2	Purchase announced in May 1978; for VIP use
31.0	..	1976	1978	12	Purchased via USAF
572.5	..	2000			Total cost: for 1 squadron; competing with F-16, F-18 and Tornado; delivery 1983–85
229.0	14.0	1976	1977	1	Initial order 1975: 8; to replace Neptune
			1978	7	
			1979	2	
9.0	..	1976	1977	6	Initial order 1976: 6; from US Navy surplus stocks
			1978	10	
..	..	1976	1979		30 launchers ordered for 2 FFG-7-class and 3 Perth-class frigates; may buy 30 more
..	..	1973	1975	24	For modernization of Perth-class frigates
			1977	24	
			1978	24	
..	260	1976	1979		Third frigate ordered in 1977; *Adelaide* due for delivery in 1979; u.c.: including 12 Mk 48 torpedoes
..	..	1975	1978	2	16 more to be licence produced
			1979	15	

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
		33	Panavia	Tornado ADV	Fighter
		192	Aérospatiale	MM-38 Exocet	ShShM
	FR Germany	55	Krauss-Maffei	Gepard	AAV
		330	Euromissile	Milan	Landmob/port
	UK	300	Alvis	Scorpion FV-101	Recce AC
		105	Alvis	Striker FV-102	AC
		3 150	BAC	Swingfire	ATM
	USA	1 224	GD/Raytheon	AIM-7E Sparrow	AAM
		(30)	LTV	MGM-52C Lance	SSM
		..	Raytheon	MIM-23B Hawk	Landmob SAM
5 Bulgaria	Czechoslovakia	(125)	Aero	L-39 Albatross	Trainer
	USSR	..	Mikoyan	MiG-23E	Fighter
		(33		FROG-9	Landmob SAM
4 Canada	FR Germany	8	Krauss-Maffei	Leopard	ARV
		6	Krauss-Maffei	Leopard	BLT
		114	Krauss-Maffei	Leopard-1-A3	MBT
	USA	18	Lockheed	CP-140 Aurora	ASW/Mar patrol
		..	Boeing	E-3A Sentry	AEW
		1 728	Hughes	BGM-71A TOW	ATM
3 China	France		Aérospatiale	Super Frelon	ASW hel
			Thomson-CSF	Crotale	Landmob SAM
		15 000	Euromissile	HOT	Landmob/port
		15 000	Euromissile	Milan	Landmob/port
			Aérospatiale	MM-38 Exocet	ShShM
	UK	30	BAC/HS	Harrier-3	Fighter
5 Czechoslovakia	USSR	..	Ilyushin	Il-76 Candid	Transport
		..	Mikoyan	MiG-23E	Fighter
		..	Sukhoi	Su-20 Fitter-C	Fighter/bomber
		..	..	(AA-7 Apex	AAM
		..	..	(AA-8 Aphid	AAM
		..	..	(FROG-9	Landmob SAM
4 Denmark	FR Germany	120	Krauss-Maffei	Leopard-1-A3	MBT
	UK	7	Aérospatiale/ Westland	Lynx	Hel

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
..	..	1977	1979		
..	..	1973	1977	48	For 4 E-71-class frigates built 1976–78
			1978	48	
..	..	1973	1978	20	
			1979	35	
2 045	..	2000			Negotiating follow-up order
..	..	1972	1975	14	Some components produced in Belgium
			1976	20	
			1977	30	
			1978	36	
..	..	1972	1977	43	Some components produced in Belgium
			1978	62	
..	..	1972	1977	1 290	For 105 Striker ACs
			1978	1 860	
..	..	1977	1979		For 102 F-16 fighters
..	..	1975	1977	(15)	Replacing Honest John in 2 battalions
			1978	(15)	
..	..	2000			Defence ministry plans to purchase for protection of Antwerp; opposition argues no threat to Antwerp
..	..	1972	1979		Entered service in 1977 in Czechoslovakia
..	..	1974	1978	(10)	Small number delivered, according to NATO sources
..	..	1976	1977	10)	Entering service in WTO, according to NATO sources
			(1978	10)	
187	..	1976	1978	8	Total cost: for 128 Leopard vehicles
187	..	1976	1978	6	Total cost: for 128 Leopard vehicles
187	..	1976	1978	57	Total cost: for 128 Leopard vehicles
			1979	57	
..	..	1976	1980	9	Special design for Canada based on P-3C Orion and S-2A Viking
			1981	9	
..	..	1978			Canada to pay $180 mn contribution to NATO AWACS programme
13.0	..	1978			150 launchers ordered
..	..	1978			Order announced in 1978
700	..	2000			Negotiating
700	..	2000			Negotiating
700	..	2000			Negotiating; total cost: including HOT and Crotale
..	..	2000			Negotiating
		(1979)			Order near finalization; will probably be licence produced
..	..	1977			Czechoslovakia and Poland first WTO states to receive new plane, after Iraq
..	..	1977	1978	(14)	First WTO state to receive; 1 squadron formed
..	..	1974			Expected to receive; so far in service only in GDR and Poland
..	..	1977	1978	84)	For MiG-23E
..	..		1978	84)	For MiG-23E
..	..	1976	1977	200)	Entering service in WTO, according to NATO sources
..	..	1975	1977	20	
			1978	23	
17.0	..	1977	1979	7	

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
	USA	46	GD	F-16A	Fighter/strike
		12	GD	F-16B	Fighter/strike
		(3 480)	Hughes	BGM-71A TOW	ATM
		(240)	MDD	RGM-84A Harpoon	ShShM
		(240)	Raytheon	Seasparrow	ShAM/ShShM
7 Finland	UK	4	BAC/HS	Hawk-1	Trainer/ground attack
	USSR	30	Mikoyan	MiG-21bis	Fighter
		180	..	AA-2 Atoll	AAM
		..	..	SA-3 Goa	Landmob SAM
		..	..	SA-6 Gainful	Landmob SAM
		(60)	..	SSN-2 Styx	ShShM
		5	..	Osa-2 class	FPB
4 FR Germany	France	24	Aérospatiale	MM-38 Exocet	ShShM
	Italy	600	Detroit Ars.	M-47 Patton	MBT
	UK	12	Aérospatiale/ Westland	Lynx	Hel
	USA	15 000	Hughes	BGM-71A TOW	ATM
		142	MDD	RGM-84A Harpoon	ShShM
5 German DR	Czechoslovakia	..	Aero	L-39 Albatross	Trainer
	USSR	..		AT-4 Fagot	Port ATM
4 Greece	France	40	Dassault	Mirage F-1C	Fighter/interc
		90	Roanne	AMX-30	MBT
		540	Euromissile	Milan	Landmob/port
		(72)	Aérospatiale	MM-38 Exocet	ShShM
	FR Germany	3	..	Type 209	Sub
		1	..	Type 209	Sub
	Italy	(120)	Selenia	Aspide-1A	ShAM
	Norway	100	Kongsberg	Penguin-2	ShShM
	UK	2	Britten Norman	BN-21 Islander	Transport
	USA	5	LTV	A-7E Corsair-2	Fighter
		..	Boeing-Vertol	CH-47C Chinook	Hel
		18	MDD	F-4E Phantom	Fighter

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
..	..	1977	1979		
..	..	1977	1979		
..	..	1976	1978	(3 480)	5 systems ordered
..	..	1975	1976	(16)	For 10 Willemoes-class frigates: 4–8 launchers/ship
			1977	(24)	
			1978	(72)	
..	..	1973	1975	(96)	NATO programme: for Peder-Shram-class and Falster-class destroyers
			1976	(96)	
			1977	(24)	
			1978	(24)	
240.0	..	1977	1979	4	Delivered prior to licence production of 46 aircraft; total of 50
..	..	1978	1978	15	To replace MiG-21F
			1979	15	
..	..	1977	1978	(90)	For 30 MiG-21bis
			1979	(90)	
..	..	1977	1978	(100)	
..	..	1977	1978	(400)	
..	..	1976			For 5 Osa-2-class FPB
..	..	1976			
121.0	..	1977			For 6 Type 162 FPB
..	..	1977	1978	50	From Italian Army surplus stocks; refurbished
134.0	2.9	1978			For Type 122 frigates
79.0	..	1977	(1978	7 500)	
			(1979	7 500)	
80.5	..	1978			
..	..	1972	1978	(15)	Recent delivery reported
..	..	1977	1978	(240)	Reported in service with GDR Army; also in service with Soviet forces in GDR
..	..	1974	1975	4	Delivery delayed
			1976	4	
			1977	3	
			1978	29	
..	..	1974	1976	15	
			1977	20	
			1978	55	
..	..	(1978)	1978	270	For 90 AMX-30 MBT
			1979	270	
..	..	1974	1977	(48)	For Combattante-3-class FPB being licence produced in Greece
..	..	1976			Order date: Sep 1976
..	..	1975			Order date: Nov 1975
..	..	1976	1978	(60)	For modernization of 5 ex-US-Navy Gearing-class destroyers: 1 8-cell launcher/ship
			1979	(60)	
..	..	1976			For 6 Combattante-2-class FPB being licence produced in Greece
..	..	1977	1978	2	
..	..	1977	(1978)	(2)	
..	..	1977	1978	(5)	Previously unreported order for small number
161.0	..	1977	(1978)	(9)	MAP order
			(1979)	(9)	

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
		1	Beech	Super King Air	Transport
		6	Vought	TA-7H Corsair-2	Trainer
		6	MDD	RF-4E Phantom	Recce
		100	GD/Raytheon	AIM-7E Sparrow	AAM
		300	Raytheon	AIM-9L	AAM
		431	Hughes	BGM-71A TOW	ATM
		. .	Raytheon	MIM-23B Hawk	Landmob SAM
		3	. .	Tang class	Sub
5 Hungary	USSR	4	Antonov	An-24 Coke	Transport
4 Italy	USA	. .	Boeing	E-3A Sentry	AEW
		208	. .	M-548	Cargo
		10 000	Hughes	BGM-71A TOW	ATM
10 Japan	USA	32	Bell	Bell-209 AH-1S	Hel
		7	Bell	Bell-212	Hel
		3	Douglas	DC-10	Transport
		9	Grumman	E-2C Hawkeye	AEW
		22	MDD	F-15A Eagle	Fighter/interc
		1	Beech	King Air C-90	Trainer
		8	Lockheed	P-3C Update-2	Fighter/ASW
		(138)	Raytheon	AIM-9L	AAM
		. .	MDD	RGM-84A Harpoon	ShShM
7 Malta	FR Germany	3	Dornier	Do-24/72	Amphibian
	Libya	4	Aérospatiale	SA-316B	Hel
		2	Aérospatiale	Super Frelon	ASW hel
4 Netherlands	FR Germany	155	Krauss-Maffei	Gepard	AAV
	Italy	288	Selenia	Seasparrow	ShShM/ShAM
	UK	8	Aérospatiale/ Westland	Lynx	Hel
		8	Aérospatiale/ Westland	Lynx	Hel
	USA	13	Lockheed	P-3C Update-2	Fighter/ASW
		850	FMC	M-113-A1	ICV
		840	Raytheon	AIM-9L	AAM
		2 300	Koll/MDD/ Raytheon	FGM-77A Dragon	Landmob/port
		(30)	LTV	MGM-52C Lance	SSM
		(288)	MDD	RGM-84A Harpoon	ShShM

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
..	..	1978	1978	1	For army
26.0	..	1977	1980		MAP order
..	..	1977	1978	(3)	
			1979	(3)	
43.0	..	1977	1978	100	For F-4E Phantom fighters
7.0	..	1977	1978	150	FMS sale, including also Bell UH-1H hel
			1979	150	
..	..	1977	1978	431	
..	..	1974	1977	(100)	In service with 1 battalion
			1978	(100)	
..	..	1977			
..	..	(1978)	1978	4	
..	..	1978			NATO allocated 5% of AWACS programme cost to Italy, who claims it can pay only token sum of $1 mn
..	..	1976	1977	(104)	
			1978	(104)	
..	..	1975	1976	2 000	To be replaced in 1991
			1977	4 000	
			1978	4 000	
..	..		1979	1	May be licence produced
..	..	1978			
..	..	2000			FY 1979 budget allocates $60 mn as first instalment for purchase of DC-10
..	..		1982		Total requirement: 15; FY 1979 funding of first 6
671.0	..	1977	1978	6	Including some F-15B trainers; FY 1978 funding;
			1979	6	delivered prior to licence production of 78 planes
1.0	..	1978			FY 1978 funding $1.68 mn
100.0	..	1978			Delivered prior to licence production of 38 planes
..	..	1976	1977	(69)	FY 1978 funding
			1978	(69)	
15.3	..	1978			Unspecified number ordered for frigates
..	..	1978			
..	..	1978	1978	4	Libyan aid to construct hel base
..	..	1978	1979	2	Based on Malta; expected transfer to Malta AF in 1979
86.0	..	1973	1978	12	First 65 ordered in 1973; all to be in service in 1980; first local designation Cheetah, now Caesar
..	..	1975	1978	(24)	NATO programme; for 12 Standard-class frigates; 1 8-cell launcher/ship
..	..	1977	1978	2	Total of 24 purchased for navy: 6 for recce and 18 for
			1979	6	ASW
22.0	..	1978	1980		For ASW frigates
437	..	1978	1981		
..	..	1975	1977	(425)	
			1978	(425)	
21.0	..	1977			For 102 F-16 fighters
37.0	..	1977	1978	(1 000)	Chosen over Milan
			1979	(1 300)	
..	..	1975	1977	(12)	For 2 battalions
			1978	(18)	
..	..	1975	1978	(24)	For 12 Standard-class frigates built 1978–85

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
4 Norway	France	900	Euromissile	Roland-2	Landmob SAM
	FR Germany	..	..	Type 210	Sub
	Netherlands	72	Fokker-VFW	F-16A	Fighter
	Sweden	..	Bofors	RBS-70	Port SAM
		5	Saab-Scania	Safir-91D	Trainer
	UK	4	Aérospatiale/ Westland	Lynx	Hel
		1	Westland	SH-3D Sea King	Hel
		..	BAC	Rapier	Landmob SAM
		10	Vickers	Vickers IKL	Sub
	USA	40	Euromissile	Roland-2 launcher	Landmob SAM
5 Poland	USSR	..	Ilyushin	Il-76 Candid	Transport
		(8)	Kamov	KA-26	Hel
				(FROG-9	Landmob SAM
4 Portugal	FR Germany	18	..	105MM	SPH
		18	Detroit Ars.	M-48 Patton	MBT
	USA	3	Lockheed	C-130H Hercules	Transport
		6	Lockheed	C-130H Hercules	Transport
		56	FMC	M-113-A1	ICV
		(320)	Hughes	BGM-71A TOW	ATM
5 Romania	France	..	Aérospatiale/ Westland	SA-330L Puma	Hel
	(USSR	..	..	FROG-9	Landmob SAM
7 Spain	France	42	Dassault	Mirage F-1A	Fighter/ground attack
		6	Dassault	Mirage F-1B	Trainer
		12	Aérospatiale/ Westland	SA-330L Puma	Hel
	Italy	12	Agusta	AB-212AS	ASW hel
		6	Boeing-Vertol	CH-47C Chinook	Hel
	Netherlands	3	Fokker-VFW	F-27 Maritime	Mar patrol
	USA	5	HS	AV-8A Harrier	Recce
		14	Bell	Bell-205 UH-1H	Hel
		5	Lockheed	C-130C Hercules	Transport
		3	Boeing-Vertol	CH-47C Chinook	Hel
		60	GD	F-16A	Fighter/strike

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
109	..	1975	1979		Missiles purchased from Euromissile, 40 launchers from USA
..	..	1976			To replace Type 207
..	..	1977			To be delivered from licence production in Netherlands
6.4	..	1978			
..	..	1978			From Swedish AF stocks
124.6	..	1978			Option on 2 more
..	..	1977	1978	1	
558	..	1978			Order depends on offset agreements for Norwegian industry; total cost: including Vickers sub and Lynx hel
558	..	2000			
108	..	1976	1979		Launcher; for Roland-2 missiles purchased from Euromissile
..	..	1977			Czechoslovakia and Poland first WTO states to receive new plane, after Iraq
..	..	1978	1978	(8)	Recent delivery reported
..	..	1976	1977)	(100)	Entering service in WTO, according to NATO sources
			(1978)	(140)	
..	..	1978	1978	18	For NATO brigade; order including 500 other unspecified vehicles
..	..	1977	1978	18	NATO aid programme
20.0	..	1977	1978	3	MAP
..	..	1978			Included in modernization programme
..	..	1977	1977	(30)	
			1978	(26)	
..	..	1978			16 systems ordered
..	..	1978			
..	..	1976	1977	100)	Entering service in WTO, according to NATO sources
			(1978	140)	
800.0	..	1978	1980		Order finalized after long negotiations; Spanish industry
			1982		to produce 20% of planes; total cost: including 6 F-1B
800.0	..	1978	1980		Total cost: including 42 F-1A
			1982		
..	..	(1978)	1978	12	Unofficial report of order
..	..	(1978)	1978	(6)	For navy
			1979	(6)	
..	..	1978	1980		
..	..	1978	1979	3	For SAR duties
29.0	..	1977	1978	5	Spanish designation: AV-8A Matador; British sale via USA for political reasons
..	..	1976	1977	7	6 for AF, 8 for army
			1978	7	
..	..	1977	1978	5	
..	..	1977	1978	3	For army
1 500.0	9.0	2000			Contract expected in 1979; total cost: basic cost for 72 aircr was $560–650 mn at 1978 prices; expected to increase to $1 000 mn with spare parts, etc. and to $1 500 mn due to 8% inflation allowance for purchasing years 1979–83

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
		38	MDD	F-4E Phantom	Fighter
		17	Hughes	Hughes-300C	Hel
		4	MDD	RF-4E Phantom	Recce
		6	Sikorsky	SH-3D Sea King	Hel
		179	FMC	M-113-A1	ICV
		18	..	M-125-A1	Cargo
		4	..	M-577-A1	Cargo
		30	Chrysler	M-60-A1	MBT
		270	GD/Raytheon	AIM-7E Sparrow	AAM
		(30)	Raytheon	AIM-9L	AAM
		1 100	Hughes	BGM-71A TOW	ATM
		40	MDD	RGM-84A Harpoon	ShShM
		(96)	Raytheon	Seasparrow	ShAM/ShShM
7 Sweden	Norway	(288)	Kongsberg	Penguin-1	ShShM
		16	..	Hugin class	FPB
	UK	..	HSD	Sky Flash	AAM
	USA	..	Raytheon	AIM-9L	AAM
		6 700	Hughes	BGM-71A TOW	ATM
		..	Hughes	AGM-65A Maverick	ASM
		100	MDD	RGM-84A Harpoon	ShShM
7 Switzerland	USA	7	Northrop	F-5E Tiger-2	Trainer
		6	Northrop	F-5F Tiger-2	Trainer
		(132)	Raytheon	AIM-9L	AAM
		11 790	Koll/MDD/ Raytheon	FGM-77A Dragon	Landmob/port
4 Turkey	FR Germany	20	Lockheed	F-104G Starfighter	Fighter
		190	Krauss-Maffei	Leopard-1-A4	MBT
		..	Euromissile	Milan	Landmob/port
		1	Howaldtswerke	Type 209	Sub
	Italy	56	Agusta	AB-205A-1	Hel
		6	Agusta	AB-212AS	ASW hel
	USA	2	Bell	Bell-205 UH-1H	Hel
		9	North American	F-100F	Fighter
		32	MDD	F-4E Phantom	Fighter
		8	MDD	RF-4E Phantom	Recce

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
..	..	1977	1978	38	
..	..	(1978)	1978	17	Chosen over OH-58A Kiowa
11.0	..	1977	1978	4	
..	..	1977	1978	6	
30.0	..	1977			Pending congressional approval; total cost: including M-125 and M-577 vehicles
13.0	..	1978			Pending congressional approval; total cost: including M-113-A1 and M-577 vehicles
13.0	..	1978			Pending congressional approval; total cost: including M-113-A1 and M-125 vehicles
..	..	1977	1978	30	
..	..	1978			
..	..	1977	1978	(30)	For AV-8A Harrier planes
8.0	..	1978			Pending congressional approval
23.0	..	1978			Pending congressional approval
..	..	1976	1978	(72)	For 4 F-30-class frigates; 1 octuple Selenia Albatross
			1979	(24)	launcher/ship with 16 reload missiles
..	..	1975	1978	(36)	For 16 Hugin-class FPB: 6 launchers/ship
33.0	..	1975	1978	2	*Hugin* and *Munin* delivered in 1978
120	..	1978			Contract date Dec 1978
..	..	2000			Government decision to cancel local development RB-72 may be reconsidered in 1979; for Viggen fighter
50.7	..	1977	1979	6 700	Total cost: including 340 launchers
..	..	2000			Government decision to cancel local development RB-05B may be reconsidered in 1979; for Viggen fighter
94.0	..	2000			Total cost: including 12 launchers; pending congressional approval; unconfirmed reports that Swedish government meanwhile cancelled order
..	..	1976	1978	7	Delivered prior to licence production of 53 aircr; offsets for Swiss industries: $1 450 mn; order including 6 F-5F trainers
..	..	1976	1978	6	Delivered prior to licence production of 53 aircr; offsets for Swiss industries: $1 450 mn; order including 7 F-5E trainers
..	..	1977	1978	(42)	For 66 F-5E/F fighters
50.0	..	1978			Order including 3 210 practice missiles
..	..	(1978)	1978	20	MAP programme, including aid to establish aerospace industry
..	..	1976	1977	(95)	
			1978	(95)	
..	..	1976	1977	(1 000)	
			1978	(1 000)	
..	..	1974	1978	1	2 more to be licence-produced
..	..	1976	1977	(28)	For army
			1978	(28)	
..	..	1976	1977	2	
			1978	4	
..	..	1977	1978	2	
1.0	..	(1978)	1978	9	From USAF surplus stocks; US export licence granted Apr 1978; MAP
..	..	1976	1977	12	Direct purchase to circumvent embargo on MAP
			1978	20	deliveries
..	..	1977	1978	4	
			1979	4	

Region code/ Recipient	Supplier	Number ordered	Manufacturer	Weapon designation	Weapon description
		33	MDD	AGM-84A Harpoon	ASM
		..	GD/Raytheon	AIM-7E Sparrow	AAM
		..	Hughes	BGM-71A TOW	ATM
		..	MDD	Honest John	SSM
		..	Raytheon	Seasparrow	ShAM/ShShM
		2	Electric Boat	Guppy-3 class	Sub
4 UK	Australia	(126)	Dept of Prod.	Ikara-2	ShShM
	France	5 000	Euromissile	Milan	Landmob/port
		(108)	Aérospatiale	MM-38 Exocet	ShShM
	Sweden	..	..	Bloodhound-1	SAM
	USA	30	Boeing-Vertol	CH-47C Chinook	Hel
		..	Hughes	BGM-71A TOW	ATM
1 USA	France	41	Dassault	Falcon-20G	Mar patrol
		90	Aérospatiale	SA-365N Dauphin	Hel
	FR Germany	200	Krauss-Maffei	Gepard	AAV
2 USSR	Finland	..	Rauma Repola	Improved Dubna class	Tanker
		(6)	..	Sorum class	Tanker
6 Yugoslavia	France	..	Aérospatiale	MM-38 Exocet	ShShM
	USSR	..	Mikoyan	MiG-23E	Fighter
				SA-9 Gaskin	Landmob SAM
		(60)	..	SSN-2 Styx	ShShM

Total cost	Unit cost	Year of order	Year of delivery	Number delivered	Comments
2.0	..	1976	1978	33	US export licence granted Apr 1978
..	..	1975	1977	(360)	For 120 F-4/F-104 fighters
			1978	(360)	
..	..	1974	1978	500	US export licence granted Apr 1978
55.4	..	1977			
6.0	..	1978			
..	..	1977	1979	2	Embargoed 1975; expected transfer in 1979
9.1	..	1977	1977	(48)	
			1978	(78)	
..	..	1976	1977	500	Delivered prior to licence production of 50 000 missiles; Euromissile sale
			1978	2 000	
			1979	2 500	
..	..	1975	1976	(12)	For 5 Amazon-class and 4 Broadsword-class frigates
			1977	(36)	
			1978	(12)	
..	..	1978			Repurchase of missiles sold to Sweden in 1961, to augment reserve stocks in UK
200.0	..	1978			
41.0	..	1978			US government offer to UK Army
..	4.9	1976	1979	6	For Coast Guard; provision made for future integration of special sensor
..	..	1978			For Coast Guard; new development to be test-flown in 1979
..	3.0	2000			Negotiating as part of attempts to arrange more US purchases of European arms in return for greater NATO standardization of armaments
..	..	1976			
..	..	1975	1978	2	
..	..	1976	1978	(24)	
..	..	1977	1978	(10)	Small number delivered, according to NATO sources
..	..	1977	1978	(200)	10 fire units reportedly delivered
..	..	1975	1977	(6)	For 10 Rade Koncar FPB: 2 launchers/ship
			1978	(12)	

Appendix 3B

Register of the arms trade with Third World countries, 1978

For sources and methods, see appendix 3C. For conventions, see page 252.

Notes: See note to appendix 3A, page 190.

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
8 Abu Dhabi	Brazil	200	Engesa	EE-9 Cascavel	Recce AC
	Canada	4	DeHavilland Can	DHC-5D Buffalo	Transport
	France	..	Dassault	Alpha Jet	Trainer
		18	Dassault	Mirage-5	Fighter
		5	Aérospatiale/ Westland	SA-330L Puma	Hel
		..	Roanne	AMX-30	MBT
		..	Thomson-CSF	Crotale	Landmob SAM
	FR Germany	4	..	Jaguar-2	FPB
	UK	..	Alvis	Scorpion FV-101	Recce AC
		..	BAC	Rapier	Landmob SAM
		1	Fairey Marine	Fairey	PB
9 Afghanistan	Czechoslovakia	..	Aero	L-39 Albatross	Trainer
	USSR	10	Antonov	An-26 Curl	Transport
		..	Mikoyan	(MiG-21MF)	Fighter
12 Algeria	Italy	10	..	..	CPB
	Netherlands	2	Fokker-VFW	F-28 MK-3000	Transport
	USA	..	Beech	T-34C-1	Trainer
	USSR	6	Mikoyan	MiG-21MF	Fighter
		20	Mikoyan	MiG-23S	Fighter
		..	Soviet State Arsenal	T-62	MBT
		3	..	Osa-2	FPB
13 Angola	Romania	16	..	BN-2A	Transport
15 Argentina	France	7	Dassault	Mirage-3E	Fighter-bomber
		4	Aérospatiale	SA-316B	Hel
		12	Aérospatiale/ Westland	SA-330J Puma	Hel
		72	Aérospatiale	MM-38 Exocet	ShShM
	FR Germany	1	Blohm-Voss	..	Frigate
	Israel	26	IAI	Kfir-C2	Fighter-bomber
		26	Dassault	Mirage-5	Fighter
		(18)	IAI	Gabriel-2	ShShM

Total cost ($ mn)	Unit cost ($ mn)	Year of order	Year of delivery	No. delivered	Comments
..	..	1977	1978	(50)	For UAE; order may include EE-11 Urutu
..	..	1977	1978	4	For UAE; to replace DHC-4 Caribou
..	..	2000	1980		For UAE
..	..	1976	1977	10	For UAE
			1978	8	
..	..	1977	1978	5	For UAE
..	..	1976			For UAE
..	..	1976	1978	(50)	For UAE; delivery delay reported similar to Shahine purchased by Saudi Arabia
..	..	1977			For UAE
..	..	1978			For UAE
..	..	1976	1978	(50)	For UAE
..	..	1976			For UAE
..	..	1978	1978	(10)	Recent delivery reported
..	..	1978	1978	10	Recent delivery reported
..	..	1978	1978	(20)	Delivered after change of régime in April 1978
..	..	1977			First delivered 1976
..	..	1978			For Navy
..	..	1978			To replace Gomhouriah
..	..	1977	1977	6	Unspecified number delivered
			1978	25	
..	..	(1977)	1978	(20)	Number believed to be 15–20; first delivered May 1978; 20 pilots trained in USSR since 1975
..	..	1977	1978	(100)	Large number reportedly being delivered
..	..	1975	1978	1	
..	..	1976	1978	16	From Romanian licence-production of British BN-2A Islander
..	..	1977	1978	7	In addition to 14 ordered earlier
..	..	1978	1978	4	
..	..	1978	1978	12	Funding for 2 CH-47C Chinook helicopters transferred to purchase of Puma
..	..	1975			For 6 Type 21 destroyers
147.8	..	1978			Order reportedly placed with Thyssen Concern
180.0	..	2000			Unconfirmed reports of order
185.0	78.0	1978	1978	13	From Israeli AF reserve stocks
			1979	13	
..	..	1975			For 2 Type 148 FPB; licence produced in Argentina: 1 triple launcher/ship

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Italy	. .	Agusta	A-109 Hirundo	Hel
		2	Aeritalia	G-222	Transport
	Netherlands	5	Fokker-VFW	F-28 MK-5000	Transport
	Switzerland	3	Pilatus	PC-6	Transport
	UK	2	Aérospatiale/ Westland	Lynx	Hel
		72	BAC	Seawolf	ShAM/ShShM
		7	Vosper		Frigate
	USA	25	MDD	A-4P Skyhawk-2	Fighter
		8	Bell	Bell-212	Hel
		5	Boeing-Vertol	CH-47C Chinook	Hel
		1	Cessna	Citation-1	Lightplane
		2	Lockheed	KC-130H Hercules	Tanker
		6	Beech	King Air E-90	Trainer
		1	Swearingen	Metro-2	Transport
		6	Grumman	S-2E Tracker	Fighter/ASW
		16	Beech	T-34C-1	Trainer
8 Bahrain	FR Germany	1	MBB	Bo-105C	Hel
9 Bangladesh	China	50	Shenyang	F-6	Fighter
	France	12	. .	Fouga Magister	Trainer
		4	Aérospatiale	SA-316B	Hel
	New Zealand	2	NZAI	CT-4 Airtrainer	Trainer
	UK	1	Denny Bros	Leopard	Frigate
14 Bahamas	UK	3	Keith Nelson	Acklins type	PB
		2	Vosper	Vosper-103	PB
		3	Vosper	Vosper-60	PB
13 Benin	Netherlands	1	Fokker-VFW	F-27 MK-600M	Transport
15 Bolivia	Argentina	18	FMA	IA-58 Pucara	Trainer/COIN
	Brazil	12	Neiva	T-25 Universal	Trainer
	Italy	6	SIAI-Marchetti	SF-260C	Trainer/COIN
	Switzerland	16	Pilatus	PC-7	Trainer
	USA	1	Lockheed	C-130H Hercules	Transport
		40	Chrysler	M-48 Patton	MBT
13 Botswana	UK	3	Britten-Norman	BN-2A Defender	Transport
		2	Short	Skyvan-3M	Transport
15 Brazil	Australia	(144)	Dept. of Prod.	Ikara-3	ShShM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1977			For Army
..	..	1974	1977	1	
			1978	1	
..	..	1976	1978	5	
..	..	(1978)	1978	3	
..	1.0	1977	1977	1	Original order of 1973 cancelled 1975; taken up in 1977
			1978	1	for 2 Type 42 destroyers
..	..	1975			For 6 Type 21 destroyers
..	..	1977			Vosper announced new order Aug 1977
..	..	1976	1977	5	Modified from A-4C with Isis sights for $10.42 mn
			1978	20	
..	..	1978	1978	8	
..	..	1978			For Army and AF
..	..	1977	1978	1	Modified for survey use
..	..	2000			AF planning to purchase
10.0	..	1978			Pending congressional approval; ordered via US Navy
..	1.0	2000			Pending congressional approval; for ambulance use
..	..	1977	1978	6	Ex-US Navy surplus stocks
9.0	..	1977			Contracted at Paris Air Show; ordered as interim type, until production starts of local design IA-62
..	..	1978	1978	1	First aircraft for newly established AF
..	..	1976	1977	14	Now being delivered according to Indian sources; pilots
			1978	36	training in China
..	..	1976	1977	5	Pilots training in France
			1978	7	
..	..	1978	(1978)	(4)	
..	..	1977	(1978)	(2)	
380	..	1978	1978	1	Ex-UK Navy
..	..	1977	1978	3	
958	..	1975	1978	2	Total cost: including 3 60-ft PB
958	..	1975	1978	3	Total cost: including 2 103-ft PB
..	..	1978	1978	1	
..	..	1975	1976	2	Production delayed
			1977	2	
..	..	2000			Production line to be re-opened to fill requirements for COIN planes
..	..	1978	1978	6	
..	..	1977	1978	8	First export customer
			1979	8	
..	1.0	1977	1978	1	For military transport line
..	..	1976	1977	(20)	Refurbished
			1978	(20)	
..	..	1977	1978	3	First aircraft for newly established AF
..	..	1978	1979	2	First aircraft for newly established AF
..	6.0	1972	1976	(48)	For 4 Niteroi-class frigates; u.c.: per system
			1977	(48)	
			1978	(48)	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	France	4	Dassault	Mirage-3E	Fighter-bomber
		(840)	Aérospatiale	AS-11	ASM
		(24)	Aérospatiale	MM-38 Exocet	ShShM
		(80)	Euromissile	Roland-1	Landmob SAM
	FR Germany	(2 000)	Euromissile	HOT	Landmob/port
		(2 000)	Euromissile	Milan	Landmob/port
	UK	9	Aérospatiale/ Westland	Lynx	Hel
		3	Wessex	Wasp	Hel
		(54)	Short	Seacat	ShAM/ShShM
		2	Vosper	Niteroi class	Frigate
	USA	2	Lockheed	KC-130H Hercules	Tanker
10 Brunei	France	36	Aérospatiale	MM-38 Exocet	ShShM
	Singapore	3	Vosper Singapore	..	FPB
	UK	2	Britten-Norman	BN-2A Defender	Transport
		16	Alvis	Scorpion FV-101	Recce AC
		..	BAC	Rapier	Landmob SAM
		..	BAE	Sabre	ATM
10 Burma	Italy	10	SIAI-Marchetti	SF-260W Warrior	Trainer/COIN
	Switzerland	18	Pilatus	PC-7	Trainer
	(USA)	4	Fairchild Hiller	FH-227	Transport
13 Cameroon	France	6	Plascoa Cannes	..	CPB
	UK	2	Hawker-Siddeley	HS-748M	Transport
13 Central African Rèpublic	France	2	Socata	Rallye-235G	Lightplane
13 Chad	France	15	Dassault/BAC	Jaguar	Fighter
15 Chile	Brazil	6	EMBRAER	EMB-111N	Mar patrol
		30	Engesa	EE-9 Cascavel	Recce AC
		10	..	..	PB
	Canada	6	DeHavilland Can	DHC-6	Transport
	India	100	Hawker-Siddeley	Hunter F-56	Fighter
	Netherlands	1	Fokker-VFW	F-27 Maritime	Mar patrol
	Spain	4	CASA	C-212C Aviocar	Transport
	USA	4	Swearingen	Merlin-3A	Lightplane
		18	Cessna	R-172K Hawk XP	Lightplane

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1977	1978	4	
..	..	1972	1974	(144)	For 140 licence produced EMB-326GB COIN aircraft
			1975	(144)	
			1976	(144)	
			1977	(144)	
			1978	(144)	
..	..	1970	1978	(24)	For 2 Niteroi-class frigates; 2 twin launchers/ship
..	..	1972	1977	(20)	For Marder vehicle; decision first announced 1972; final
			1978	(20)	order date unknown; 4 systems ordered
..	..	1977			For EE-9 Cascavel vehicles
..	..	1977			For EE-11 Urutu vehicles
18.0	..	1975	1977	2	For 6 Niteroi-class frigates; may be armed with Sea
			1978	7	Skua AShM
..	..	1978	1978	3	
..	..	1972	1976	18	For 6 Niteroi-class frigates
			1977	18	
			1978	18	
400	..	1970	1978	2	One more licence produced in Brazil; completed 1978
..	..	1977	1978	2	
..	..	1976	1978	36	For 3 Vosper FPB: 2 launchers/ship
..	..	1976	1978	3	Built by Vosper Singapore, 37-ft
..	..	2000			Planning to purchase, according to unofficial reports
..	..	1976	1978	16	
75.0	..	2000			Planning to purchase 1 battery according to unofficial reports
58.7	..	1979			Contracted early 1979
..	..	1976	1978	10	
..	..	1977	1978	4	Delivery began Nov 1978 from first production run of
			1979	14	35 planes
..	..	1978	1978	4	Commercial sale by Allegheny Airlines; refurbished in Taiwan
..	..	1976	1978	3	
..	..	1976	1978	2	
..	..	1977	1978	2	
..	..	1977	1978	15	Massive airlift of troops and material in 1978 including Jaguar fighters
..	..	1977	1977	3	First export customer of maritime patrol version
			1978	3	
..	..	1978			
..	..	1976			Seller previously reported as USA
..	..	1977	1978	6	
..	..	2000			Chile wants to purchase, including spare parts, due to difficulties in acquiring new weapons
..	..	1976	1978	1	
..	..	1978	1978	4	Sale not announced by CASA
..	..	1976	1977	2	For AF
			1978	2	
1.0	..	1978	1978	18	For training; contracted by Army Aero Club

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
15 Colombia	Portugal	4	..	..	Corvette
	USA	6	Cessna	A-37B Dragonfly	Fighter/COIN
		6	Cessna	T-37C	Trainer/COIN
		12	Lockheed	T-33A	Trainer
		..	Beech	T-34B Mentor	Trainer
		2	Tacoma	Asheville class	PB
13 Comoros Islands	USA	1	Douglas	C-47	Transport
		1	Bethlehem Steel	Duval Country class	LST
13 Congo	France	1	Aérospatiale	Nord-262A-1	Transport
	USSR	2	Antonov	An-24 Coke	Transport
14 Cuba	USSR	..	Mikoyan	MiG-27	Fighter/strike
		1	..	Foxtrot class	Sub
		2	..	Osa-2 class	FPB
		2	..	Turya class	Hydrofoil TB
13 Djibouti	France	1	..	Tecimar type	GB
8 Dubai	Italy	1	Aeritalia	G-222	Transport
15 Ecuador	France	3	Dassault	Fouga Magister	Trainer
		2	Dassault	Mirage F-1B	Trainer
		18	Dassault	Mirage F-1C	Fighter/interc
		(72)	Matra	R-550 Magic	AAM
	FR Germany	2	Howaldtswerke	Type 209	Sub
	Israel		IAI	IAI-201 Arava	Transport
	Italy	6	Riuniti		Corvette
	UK	12	Dassault/BAC	Jaguar	Fighter
	USA	2	Lockheed	C-130H Hercules	Transport
		4	Lockheed	Electra L-188	Transport
		14	Beech	T-34C-1	Trainer
		44	..	Vulcan	SPG
		3	Ford/Raytheon	Chaparral	Landmob SAM
		..	..	Flagstaff-2	Hydrofoil FPB
8 Egypt	France	20	Aérospatiale/MBB	C-160F Transall	Transport
		40	Dassault	Mirage F-1C	Fighter/interc
		14	Dassault	Mirage-5R	Recce
		42	Aérospatiale/ Westland	SA-342K Gazelle	Hel
		20	Aérospatiale/ Westland	SA-342L Gazelle	Hel
		(24)	Aérospatiale	AS-12	ASM
		..	Thomson-CSF	Crotale	Landmob SAM
		60	Matra/Oto Melara	Otomat-2	ShShM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
80.0	..	2000			
..	..	1977	1978	6	
..	..	1977	1978	6	
..	..	1977	1978	12	From USAF surplus stocks
..	..	1977	1978	10	From US Navy surplus stocks
..	..	1977	1978	2	
		1977	1978	1	Delivered to AF; may be civil version DC-3
..	..	1978	1978	1	Formally transferred early 1978; to be refurbished before delivery
..	..	1976	1978	1	From new production
..	..	1978	1978	2	Transferred to AF from national air line service
..	..	1978	1978	(10)	Designation: MiG-23E; Cuban and Soviet governments declared planes not armed with nuclear weapons
			1978	10	
..	..	1978	1978	1	
..	..	1978	1978	2	
..	..	1978	1978	2	
..	..	1977	1978	1	
..	..	1977	1978	1	
..	..	1978	1978	3	Ex-French AF; refurbished
105	..	1978	1979	2	Ordered instead of Kfir-C2
130	..	1978	1979	9	Ordered instead of Kfir-C2
			1980	9	
..	..	1974	1977	12	For 12 Jaguar fighters
			1977	(36)	
			1978	(36)	
..	..	1977			
..	..	1976			
200	..	1978			
68.0	5.0	1974	1977	6	
			1978	6	
..	..	1976	1978	2	
..	..	1976	1978	4	
..	..	1975	1978	14	Order confirmed 1976
219	..	2000			US DOD proposed sale of Vulcan/Chaparral air defence system
219	..	2000			Number ordered: 3 battalions; total cost: including Vulcan SPG; launch vehicle: M-730
..	..	1977			
..	..	1976			Production line re-opened
..	..	2000			Funding by Saudi Arabia
..	..	1977	1978	14	
..	..	1975	1976	10	
			1977	24	
			1978	8	
..	..	1978			
..	..	1975	1978	(24)	For 4 Commando MK-2 helicopters
..	..	1976			Designation Arab-Crotale; licence production planned
217	..	1978			Egypt first export customer of coastal defence version

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Italy	30	Matra/Oto Melara	Otomat-1	ShShM
		2	..	Lupo class	Frigate
	UK	4	Westland	Commando Mk-2	Hel
		200	BAC/HS	HS Hawk-1	Trainer/ground attack
		12	Hawker-Siddeley	HS-748-2A	Transport
		1	..		Destroyer
		3	Vosper		FPB
		2	..		Frigate
		6	Vosper		GB
		3	..	SRN-6	Hovercraft
		1	Scotts		Sub
	USA	14	Lockheed	C-130H Hercules	Transport
		42	Northrop	F-5E Tiger-2	Trainer
14 El Salvador	Brazil	12	EMBRAER	EMB-111	Land mar patrol
	France	3	Dassault	Fouga Magister	Trainer
	Israel	25	IAI	IAI-201 Arava	Transport
13 Equatorial Guinea	USSR	1	..	P-6 class	FPB
		1	..	Poluchat class	PB
13 Ethiopia	USSR	10	Mil	Mi-6 Hook	Hel
		30	Mil	Mi-8 Hip	Hel
		46	Mikoyan	MiG-17	Fighter
		100	Soviet State Arsenal	T-54	MBT
		..	Soviet State Arsenal	T-55	MBT
		..	..	T-70	MBT
		(2 000)	..	AT-3 Sagger	ATM
		(500)	..	SA-3 Goa	Landmob SAM
		(3 000)	..	SA-7 Grail	Landmob/port
13 Gabon	France	1	Esterel		FPB
	FR Germany	2	..	Jaguar-2 class	FPB
	Italy	2	Sarzana		PB
13 Guinea Bissau	France	1	Reims	Cessna F337	Trainer
		2	..		GB

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1977	1978	15	To replace Styx on 8 Osa-2-class and 5 Komar-class FPB
			1979	15	
..	..	2000			Will order
..	..	1975	1978	4	
..	..	1978			May be licence-produced
..	..	2000			Will order
..	..	2000			Negotiating for HMS *Devonshire*, completed 1962; to be modernized before transfer
330	..	1978			
..	..	2000			Negotiating for HMS *Lincoln*, completed 1960 and HMS *Salisbury* of 1957; to be modernized before transfer
288	..	1978			
..	..	1977			
..	..	1978			
184	..	1977			Total cost: including 12 RPV for $130 mn; 6 recce cameras $17 mn, and training; funding by Saudi Arabia
700	..	1978			Included in US package sale to the Middle East 1978
..	..	1977	1978	6	
			1979	6	
..	..	1977	1978	3	From reserve stocks; sold by Aérospatiale
..	0.7	1973	1974	1	
			1975	4	
			1976	4	
			1977	8	
..	..	1977	1978	1	
..	..	1977	1978	1	
..	..	1977	1978	(10)	
..	..	1977	1977	(15)	Delivered after war with Somalia began
			1978	(15)	
..	..	1977	1977	6	Delivered since Jan 1978
			1978	40	
385	..	1977	1977	(50)	Reportedly 200 T-54/55 delivered over 2 years; total cost: including aircraft and missiles according to agreement of May 1977
			1978	(50)	
385	..	1977	1977	(40)	Reportedly 200 T-54/55 delivered over 2 years; total cost: including aircraft and missiles according to agreement of May 1977
			1978	(60)	
..	..	1977	1978	(30)	Reportedly recently delivered with 150-mm guns
385	..	1977	1977	(1 000)	Large number reportedly delivered
			1978	(1 000)	
385	..	1977	1977	(300)	Large number reportedly delivered
			1978	(200)	
385	..	1977	1977	(1 500)	Large number reportedly delivered
			1978	(1 500)	
..	..	1976	1978	1	
..	..	1976			Arms: 2×76-mm Oto Melara AA-cannon
..	..	1975	1977	1	
			1978	1	
..	..	1978	1978	1	Nominal AF being set up; no defence forces since 1974
..	..	1977			

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
13 Ghana	FR Germany	2	Lürssen Werft	..	PB
		2	Lürssen Werft	..	PB
	Italy	8	Aermacchi	MB-326K	Trainer
14 Guatemala	Israel	10	IAI	IAI-201 Arava	Transport
		..	IAI	Kfir-C2	Fighter-bomber
	USA	6	Northrop	F-5E Tiger-2	Trainer
14 Honduras	Israel	6	..	Mystère-4A	Fighter-bomber
	Morocco	8	..	T-28S Fennec	Trainer/ground attack
	UK	..	Alvis	Scorpion FV-101	Recce AC
9 India	Canada	..	DeHavilland Can	DHC-5D Buffalo	Transport
	France	12	Dassault	Breguet Alize	Fighter/ASW
	Ghana	5	DeHavilland Can	DHC-4 Caribou	Transport
	UK	5	Britten-Norman	BN-2A Defender	Transport
		40	Dassault/BAC	Jaguar	Fighter
		30	..	Sea Harrier	Fighter/ASW
		5	..	SH-3D Sea King	Hel
		1 000	Avadi	Vijayanta-2	MT
		(144)	Short	Seacat	ShAM/ShShM
	USA	2	Boeing	Boeing-737-100	Transport
	USSR	2	Ilyushin	Il-38 May	ASW/mar patrol
		5	Kamov	Ka-25 Hormone	Hel
		70	..	T-72	MBT
		..	..	SA-3 Goa	Landmob SAM
		(96)	..	SSN-11	ShShM
		2	..	Kashin class	Destroyer
10 Indonesia	Australia	8	Bell	Bell-47G-3	Hel
		6	GAF	N-22B Nomad	Transport
		2	Evans D/Walkers	Attack class	PB
	France	6	Aérospatiale/ Westland	SA-330L Puma	Hel
		(36)	Aérospatiale	MM-38 Exocet	ShShM
		4	Fokker VFW	F-27 MK-400	Transport
		2	Howaldtswerke	Type 209	Sub
	South Korea	4	Tacoma Korea	PSMM-5 class	FPB

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1977			Arms: 1 × 76-mm Oto Melara AA-cannon; 45-m
..	..	1977			Arms: 1 × 76-mm Oto Melara AA-cannon; 58-m
..	1.0	1976	1977	4	Delivery Sep 1977–1978
			1978	4	
..	..	1977	1977	(7)	
			1978	(3)	
..	..	2000			Considering purchase of 1 squadron
30.0	..	(1978)			Pending congressional approval; defence pact with USA broken off 1977
..	..	1977	1978	6	From Israeli AF stocks; second order
..	..	1978	1978	8	From Moroccan AF stocks
..	..	1978			
..	..	(1979)			Decision expected 1979
..	..	1977	1978	12	To be refurbished for aircraft carrier Vikrant
..	..	1978			Delivery via Switzerland delayed due to funding problems; from Ghana AF stocks
..	..	1977	1978	5	For Navy; will be transferred to newly formed Coast Guard
..	..	1978			Delivery prior to licence production of 160 planes
..	..	2000			Navy order for aircraft carrier Vikrant
..	..	1977			For 3 Leander-class frigates
..	..	1965	1975	100	
			1976	100	
			1977	100	
			1978	100	
..	..	1972	1972	(24)	For 6 Leander-class frigates: 2 quadruple launchers/ship
			1974	(24)	
			1976	(24)	
			1977	(24)	
12.0	..	1977	1978	2	For AF VIP transport
..	..	1977	1978	2	Option on 2 taken up, in addition to 4 delivered 1977
..	..	1976	1978	5	For 2 Kashin-class destroyers; purchased as interim type, pending start of production of local design
..	..	1978	1979		Contracted Feb 1978; to replace licence produced Vijayanta MBT from 1979
..	..	1977	1978	(500)	Reportedly recently delivered; Indian designation: Pichora
..	..	1976	1977	(48)	For 8 Nanuchka-class destroyers; to replace SSN-9 ShShM
			1978	(48)	
..	..	1976	1978	2	
..	..	1978	1978	8	At least 8 purchased from Australian Army stocks
..	..	1977	1978	6	MAP
..	..	1978	1978	2	
..	..	1977	1978	6	Delivered prior to licence-production of 30 hel
..	..	1976	1979		For 3 FPB purchased from Netherlands
			1980		
..	..	1977	1978	4	Unconfirmed order
..	..	1977			Modified enlarged version; FRG government approval Feb 1977
..	..	1976	1979		From licence production in South Korea; may buy 14 more

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Netherlands	3	Wilton		Corvette
	UK	8	BAC/HS	HS Hawk-1	Trainer/ground attack
	USA	16	MDD	A-4M Skyhawk-2	Fighter-bomber
		16	Bell	Bell-205 UH-1H	Hel
		12	Northrop	F-5E Tiger-2	Trainer
		4	Northrop	F-5F Tiger-2	Trainer
		16	Beech	T-34C-1	Trainer
		16	GD	RIM-66A/SM-1	ShAM/ShShM
8 Iran	France	12	CMN	Kaman	FPB
	FR Germany	4	. .	Type 122	Frigate
		6	Howaldtswerke	Type 209	Sub
	Italy	50	Agusta	CH-47C	Hel
		3	Agusta	SH-3D Sea King	Hel
	Netherlands	8	. .	Kortenaer class	Frigate
	UK	175	Vickers	Chieftain	ARV
		1 200	Vickers	Chieftain-5	MBT
		1	Swan Hunter		Fleet repl
		4	Yarrow		Support
	USA	287	Bell	Bell-214A	Hel
		39	Bell	Bell-214C	Hel
		1	Boeing	Boeing 707-320C	Transport
		4	Boeing	Boeing 747-200F	Transport
		10	Grumman	E-2C Hawkeye	AEW
		7		E-3A Sentry	AEW
		3		E-3A Sentry	AEW
		80	Grumman	F-14A Tomcat	Fighter/strike
		70	Grumman	F-14A Tomcat	Fighter/strike
		160	GD	F-16A	Fighter/strike
		140	GD	F-16A	Fighter/strike
		250	Northrop	F-18L Cobra	Hell
		5	MDD	RF-4E Phantom	Recce
		11	MDD	RF-4E Phantom	Recce
		100	FMC	M-113-A1	ICV
		100	. .	M-548	Cargo
		1 000	Texinst/Univac	AGM-45A Shrike	ARM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1975	1979	1	Arms: Bofors 375-mm RL
13.0	..	1978			Contract signed Apr 1978
7.0	..	2000			Recent offer by USA; total cost expected to be below $7 mn which is necessary for congressional approval
..	..	1977	1978	16	For Army
125	..	1977			USA agreed to sell 1978; first ordered in 1977; total cost: including 4 F-5F trainers
125	..	1977			USA agreed to sell 1978; first ordered in 1977; total cost: including 4 F-5F trainers
8.0	..	1977	1978	16	Ordered via Hawker-Havilland of Australia, as agents for Beech in SE Asia
..	..	1976	1979		For PSMM-5 FPB; 4 launchers/ship
57.0	..	1974	1978	2	Version of Combattante-3 FPB; arms: Bofors cannon
..	..	1978			To be based at Chah Bahar
575	..	1978			Deal concluded after President Scheel's visit to Iran in Apr 1978
425	..	1977	1978	(20)	Arms-for-oil deal: 5 mn t crude oil to be delivered 1978–80
..	..	1977	1978	3	VIP version
..	..	1978			Deal negotiated at same time as Type 122 frigates from FRG
..	..	1977			Negotiations resumed 1977; Iran wanted arms-for-oil deal
..	..	1976	1980		Special version with Chobham armour; arms-for-oil deal
..	..	1974	1978	1	
94.0	..	1977	1981		Arms-for-oil agreement discussed
..	..	1972	1975	45	Version known as Isfahan; most of R&D paid by Iran; to be licence produced
			1976	105	
			1977	120	
			1978	17	
..	..	1976	1976	3	
			1977	30	
			1978	6	
..	..	1977	1978	1	
200	..	1977	1977	1	
			1978	3	
..	26.0	1978			
..	1 200	1977	1981	1	
..	..	1978			
2 300	7.0	1974	1976	20	
			1977	36	
			1978	24	
..	..	2000			Letter of request; Iran AF claims minimum of 450 combat aircraft needed
3 800	20.0	1977	1980		Order date 1976; US government approval in 1977; arms-for-oil deal
..	..	2000			Letter of request
4 000	15.0	2000			Version under development by Northrop to meet Iranian requirement
..	..	1977	1979	5	Congress approved sale
170	..	1978			Pending congressional approval
..	..	1976	1978	100	
11.0	..	1978			
105	..	1978			Iran accepted US offer, for use with F-4E Phantom fighters rather than vetoed purchase of F-4G Wild Weasel fighters

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		(480)	Hughes	AIM-54A Phoenix	AAM
		(516)	GD/Raytheon	AIM-7E Sparrow	AAM
		(186)	Raytheon	AIM-9H	AAM
		(1 502)	Raytheon	AIM-9L	AAM
		(10 000)	Koll/MDD/ Raytheon	FGM-77A Dragon	Landmob/port
		..	Raytheon	MIM-23B Hawk	Landmob SAM
		222	MDD	RGM-84A Harpoon	ShShM
			..	RIM-67A/SM-1	ShAM/ShShM
		4	..	Spruance class	Destroyer
		2	..	Taft type	PB
		3	Portsmouth/Elec	Tang class	Sub
	USSR	(200)	Soviet State Arsenal	Asu-85	SPG
		(500)	..	BMP-76	APC
		(200)	..	ZSU-23-4 Shilka	SPG
8 Iraq	Czechoslovakia	24	Aero	L-39 Albatross	Trainer
	France	4	Dassault	Mirage F-1B	Trainer
		36	Dassault	Mirage F-1C	Fighter/interc
		40	Aérospatiale/ Westland	SA-330L Puma	Hel
		60	Aérospatiale/ Westland	SA-342K Gazelle	Hel
		..	Giat	AMX-10P	AC
		..	Roanne	AMX-30	MBT
		..	Aérospatiale	AM-39 Exocet	ASM
		..	Thomson-CSF	Crotale	Landmob SAM
		360	Euromissile	HOT	Landmob/port
		..	Matra	R-550 Magic	AAM
	Switzerland	48	FFA	AS-202 Bravo	Trainer
		16	Farner-Pilatus	MBB-223K	Trainer
	USA	8	Lockheed	C-130H Hercules	Transport
	USSR	..	Antonov	An-26 Curl	Transport
		..	Ilyushin	Il-76 Candid	Transport
		..	Mil	Mi-10 Harke	Hel
		138	Mikoyan	MiG-23S	Fighter
		(500)	..	SA-6 Gainful	Landmob SAM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1974	1976	(120)	For 80 F-14A fighters
			1977	(216)	
			1978	(144)	
14.0	..	1977	1980		For 160 F-16A fighters to be delivered from 1980
..	..	1978	1980		For first batches of 160 F-16A fighters to be delivered from 1980
..	5.0	1975	1976	(566)	For 80 F-14A fighters delivered 1976–78
			1977	(646)	
			1978	(288)	
..	..	1977	1977	(5 000)	
			1978	(5 000)	
184	..	1977	1978	(200)	Order date unconfirmed
..	..	1974	1979		For 12 Kaman-class FPB: 2 twin launchers/ship; to be delivered from 1979
..	..	1974	1980		For 4 Spruance-class destroyers to be delivered from 1980
796	..	1974	1980	1	Crew training in USA
			1981	3	
39.0	..	1978			
54.0	..	1975	1978	3	
414	..	1976	1977	(100)	Total cost: including SA-7 and SA-9 SAM, vehicles and cannon
			1978	(100)	
414	..	1976	1977	(125)	Total cost: including SA-7 and SA-9 SAM, vehicles and cannon
			1978	(125)	
414	..	1976	1977	(100)	Total cost: including SA-7 and SA-9 SAM, vehicles and cannon
			1978	(100)	

..	..	1973	1978	(10)	Delivery started in Nov 1978
..	..	1977	1978	4	French offer of 1975
..	..	1977	1978	18	French offer of 1975
			1979	18	
280	..	1977	1978	(20)	Total cost: including F-1C fighter, R-550 Magic AAM
..	..	1976	1978	10	
280	..	1977	1978	(50)	Total cost: including F-1C fighters, SA-330L Puma hel, R-550 Magic AAM, AMX-30 MBT, AMX-10P AC
280	..	1977	1978	(20)	Total cost: including F-1C fighters, SA-330L Puma hel, R-550 Magic AAM, AMX-30 MBT, AMX-10P AC
..	..	1978	1978	(60)	For SA-342 hel
..	..	2000			Requested
..	..	1976	1978	60	For SA-342K hel
280	..	1977	1978	(108)	Large number purchased for F-1 fighters
			1979	(108)	
..	0.1	1978			U.c.: $0.1 mn in standard form, $0.2 mn fully equipped
..	..	1977			Design: originally Flamingo, FRG; sole production line now in Switzerland
..	..	1976			US government provisionally authorized sale
..	..	1976	1977	2	First 2 delivered early 1977; more expected
			1978	(10)	
..	..	1978	1978	(2)	Iraq to receive new 4-engined long-range transport before Czechoslovakia and Poland
..	..	1978	1978	(20)	
4 000	..	1976	1977	(35)	Agreement in Aug 1976; based at naval base Shaibe; total cost: including vehicles, ships, missiles
			1978	(35)	
4 000	..	1976	1977	(100)	Total cost: including MiG-23 fighters, ships, vehicles
			1978	(400)	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		(60)	..	SSN-2 Styx	ShShM
		10	..	Osa-2 class	FPB
8 Israel	UK	(36)	Short	Blowpipe	Port SAM
		3	Vickers	Type 206	Sub
	USA	18	Bell	Bell-209 AH-1S	Hel
		4	Grumman	E-2C Hawkeye	AEW
		23	MDD	F-15A Eagle	Fighter/interc
		15	MDD	F-15A Eagle	Fighter/interc
		75	Gen Dynamics	F-16A	Fighter/strike
		5	Sikorsky	HH-53C	Hel
		30	Hughes	Hughes-500MD	Hel
		(100)	Allison Div.	M-109-A1	SPH
		15	Chrysler	M-728	AEV
		200	Texinst/Univac	AGM-45A Shrike	ARM
		(300)	GD/Raytheon	AIM-7F Sparrow	AAM
		170	GD/Raytheon	AIM-7F Sparrow	AAM
		(300)	Raytheon	AIM-9L	AAM
		200	Hughes	BGM-71A TOW	ATM
		60	Raytheon	MIM-23B Hawk	Landmob SAM
		100	MDD	RGM-84A Harpoon	ShShM
13 Ivory Coast	Canada	..	DeHavilland Can	DHC-5D Buffalo	Transport
	France	12	Dassault	Alpha Jet	Trainer
		6	Panavia	Tornado ADV	Fighter
		1	Dubigeon	Batral type	Transport
		2	CN Darcachon	..	FPB
	Netherlands	1	Fokker-VFW	F-27 Maritime	Mar patrol
14 Jamaica	UK	1	Britten-Norman	BN-2A Defender	Transport
8 Jordan	USA	10	Bell	Bell-209 AH-1S	Hel
		1	Lockheed	C-130H Hercules	Transport
		4	Northrop	F-5E Tiger-2	Trainer
		4	Sikorsky	S-76	Hel

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
4 000	..	1976	1978	(12)	For 10 Osa-2-class FPB; total cost: including MiG-23 fighters, ships, vehicles
4 000	..	1976	1978	2	Total cost: including MiG-23 fighters, missiles, vehicles
..	..	1972	1977	(24)	For 3 Type 206 sub delivered 1977–78: 4 launchers/sub
			1978	(12)	
125	..	1972	1978	1	
54.0	..	1977	1977	6	
			1978	12	
187	..	1976	1977	2	Option on 2 more
			1978	2	
650	15.0	1975	1976	4	
			1977	15	
			1978	4	
431	..	1978	1981		Included in US sales package to Middle East, approved Feb 1978; total cost: including 75 F-16A fighters
1 900	6.0	1978	1980		Israel may develop local design Arye, since USA refused co-production of F-16A and reduced number ordered from 250 to 75
..	..	1976	1977	1	
			1978	4	
..	..	1978	1979		
..	..	1976	1977	(50)	
			1978	(50)	
115	..	1977	1977	(5)	Total cost: including M-113-A1 AC and BGM-71A TOW; US government approval in 1977
			1978	(10)	
..	..	1978			
..	..	1975	1976	(48)	For 25 F-15A delivered in 1976–78
			1977	(204)	
			1978	(48)	
24.0	..	1978			
32.0	..	1975	1976	(48)	For 25 F-15A delivered in 1976–78
			1977	(204)	
			1978	(48)	
10.0	..	1977	1977	72	For 18 Bell-209 hel delivered 1977–78
			1978	128	
9.0	..	1978			Pending congressional approval; total cost: including 2 radar sets
14.0	..	1975	1978	50	FMS sale
			1979	50	
..	..	1976	1978	5	
..	..	1977	1980		First 6 ordered 1977, expanded to 12 in 1978
			1981		
..	..	1977	1979		
..	..	1977			
..	..	1977	1978	2	
..	..	1978			
..	..	1977	1978	1	
..	..	2000			US government approved sale but contract not final, since Saudi Arabia so far refused funding
..	..	1978			
..	..	1978			Contracted via USAF
..	..	1976	1978	4	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		..	FMC	M-110	SPH
		700	FMC	M-113-A1	ICV
		100	..	M-48 Patton	MBT
		100	Chrysler Corp.	M-60-A1	MBT
		60	Hughes	BGM-71A TOW	ATM
		532	Raytheon	MIM-23B Hawk	Landmob SAM
		100	..	Vulcan	SPG
10 Kampuchea	China	..	Shenyang	F-4	Fighter
		..	State Arsenal	T-60	Amph LT
		..	State Arsenal	AT-3	ATM
13 Kenya	Canada	4	DeHavilland Can	DHC-5D Buffalo	Transport
	France	6	Aérospatiale/ Westland	SA-330L Puma	Hel
	FR Germany	6	Dornier	Do-28D-2	Transport
	Israel	..	..	..	PB
	UK	6	BAC	BAC-167	Trainer/COIN
		2	Britten-Norman	BN-2A Defender	Transport
		9		Bulldog-103	Trainer
		12	BAC/HS	HS Hawk-1	Trainer/ground attack
		40	Vickers	MBT-3	MBT
	USA	10	Northrop	F-5E Tiger-2	Trainer
		2	Northrop	F-5F Tiger-2	Trainer
10 South Korea	France	..	Aérospatiale	MM-38 Exocet	ShShM
	USA	72	Fairchild	A-10A	Fighter
		45	Bell	Bell-205 UH-1H	Hel
		6	Lockheed	C-130H Hercules	Transport
		6	Boeing-Vertol	CH-47C Chinook	Hel
		18	MDD	F-4E Phantom	Fighter
		54	Northrop	F-5E Tiger-2	Trainer
		14	Northrop	F-5E Tiger-2	Trainer
		34	Hughes	Hughes-500MD	Hel
		15	Bowen-McLaugh	M-88-A1	Cargo
		341	GD/Raytheon	AIM-7E Sparrow	AAM
		600	Raytheon	AIM-9L	AAM
		(1 152)	Hughes	BGM-71A TOW	ATM
		2 208	Hughes	BGM-71A TOW	ATM
		..	MDD	Honest John	SSM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
12.0	..	1977	1978	10	
..	..	1976	1977	100	Deal includes 150 cannons
			1978	220	
..	..	1976	1977	(50)	
			1978	(50)	
..	..	1976	1977	(50)	
			1978	(50)	
..	..	1977			Pending Saudi Arabia funding; for 10 Bell-209 hel
540	..	1974	1977	(266)	Funding by Saudi Arabia; total cost: including Vulcan SPG; cost escalation from original $260 mn
			1978	(266)	
..	87.0	1974			Funding by Saudi Arabia
..	..		1978	(25)	Unknown number reportedly delivered
..	..	1977	1978	(100)	Chinese military aid began in Jan 1978, including vehicles and long-range artillery
..	..	1978	1978	200	Reportedly recently delivered by sea, including mines, 130-mm cannons
25.0	..	1976	1977	2	To replace DHC-4 Caribou
			1978	2	
..	..	1977	1978	6	Previously unannounced order
..	..	1977	1978	6	
..	..	1978			Unconfirmed order; from Israeli Navy surplus stocks
..	..	1977	1978	6	
..	..	1977	1978	2	
..	..	1977	1978	9	
..	..	1978	1980		
..	..	1977	1978	(20)	Deal includes unspecified ARV
			1979	(20)	
75.0	..	1976	1977	4	Total cost: including 2 F-5F trainers
			1978	6	
75.0	..	1976	1978	2	Total cost: including 10 F-5E fighters
..	..	1978	1978	(50)	Unspecified number ordered
..	..	1978			Number ordered: 42–72; pending congressional approval
40.0	..	1977			Pending congressional approval
76.0	..	1978			Pending congressional approval
31.0	..	1978			Pending congressional approval; deal includes spare parts, support equipment for $8.7 mn
134	..	1977	1979		
205	..	1975	1978	25	Total cost: including 6 F-5F trainers
			1979	29	
50.0	..	1977	1978	4	
		1976	1978	30	Delivered prior to licence production of 66 hel
12.0	..	1977	1978	15	Pending congressional approval
56.0	..	1977	1979	341	For 18 F-4E Phantom fighters, to be delivered from 1979
..	..	1975	1977	60	For 60 F-5E fighters
			1978	200	
			1979	220	
..	..	1976	1977	(360)	For 96 Hughes-500 MD: 4 launchers/hel
			1978	(360)	
8.0	..	1978			Pending congressional approval; total deal worth $67 mn, of which $59 mn for spare parts for aircraft already in service
..	..	1977	1978	480	Transferred from US forces in Korea; 24 systems

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		200	Hughes	AGM65A Maverick	ASM
		48	Raytheon	MIM-23B Hawk	Landmob SAM
		120	MDD	RGM-84A Harpoon	ShShM
		4	Tacoma	Asheville class	LST
		1	..	Grasp type	PB
8 Kuwait	France	120	Aérospatiale	MM-38 Exocet	ShShM
		(120)	Matra	Super R-530	AAM
	Singapore	1	Vosper Singapore		LC
	UK	18	Dassault/BAC	Jaguar	Fighter
		165	Vickers	Chieftain-5	MBT
		10	Vosper	..	FPB
	USA	30	MDD	A-4M Skyhawk-2	Fighter-bomber
		6	MDD	TA-4K Skyhawk-2	Trainer
		300	Raytheon	AIM-9H	AAM
	USSR	..	..	SA-6 Gainful	Landmob SAM
		..	..	SA-7 Grail	Landmob/port
10 Laos	USSR	3	Antonov	An-26 Curl	Transport
8 Lebanon	France	70	Creusot-Loire	AMX-13	LT
		30	Roanne	AMX-30	MBT
		200	Euromissile	Milan	Landmob/port
		3	..		PB
	FR Germany	3	..		PB
13 Lesotho	UK	2	Short	Skyvan-3M	Transport
13 Liberia	USA	10	Cessna	Cessna-337	Trainer
12 Libya	Brazil	200	Engesa	EE-11 Urutu	APC
		200	Engesa	EE-9 Cascavel	Recce AC
	France	16	Dassault	Mirage F-1A	Fighter/ground attack
		120	Aérospatiale	MM-38 Exocet	ShShM
		..	Matra/Oto Melara	Otomat-1	ShShM
		(232)	Matra	R-550 Magic	AAM
		6		PR-72 class	FPB
		2	CNIM	PS-700 class	LST
	Italy	20	Aeritalia	G-222L	Transport
		110	SIAI-Marchetti	SF-260W Warrior	Trainer/COIN

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
10.0	..	1976	1978	150	For 60 new F-5E fighters
82.0	..	1977	1978	48	US government approved sale in 1977; pending congressional approval
80.0	..	1975	1978	(60)	For Paek Ku-class frigates and FPB
			1979	(60)	
..	..	(1978)			To be purchased instead of licence production of 7 Tacoma FPB, for financial reasons
..	..	1978	1978	1	
..	..	1978			For 10 Vosper FPB
..	..	1977	1978	(120)	For 20 Mirage F-1 fighters
..	..	1977			88-ft
..	..	1977			
..	..	1977			Order first announced in 1976; may purchase total of 300
350	..	1978			
..	..	1975	1977	15	Ordered via US Navy; pilots training in USA
			1978	15	
..	..	1975	1977	4	Ordered via US Navy; pilots training in USA
			1978	2	
32.0	..	1975	1977	150	For 30 A-4M fighters delivered 1977–78
			1978	150	
..	..	1978			According to local sources; total cost: including SA-7, $100 mn
..	..	1978			According to local sources, total cost: including SA-6, $100 mn
..	..	1978	1978	3	
250	..	1978	1978	70	MAP
..	..	1978	1978	30	MAP
3.5	..	1978			
250	..	1978	1978	3	MAP
..	..	1976			
..	..	1978	1978	2	Lesotho has no armed forces since independence in 1966; for police mobile unit
..	..	1977	1978	10	
..	..	1978			Unconfirmed order
400	..	1977	1978	100	Total cost: including 200 EE-11 Urutu APC
			1979	100	
..	..	1975	1977	8	
			1978	8	
..	..	1975	1977	(48)	For 10 Combattante-3-class FPB
			1978	(72)	
..	..	1974	1978	(48)	For 4 Italian corvettes
..	..	1975	1977	116	For 38 Mirage F-1 fighters
			1978	116	
..	..	1977			Unconfirmed order
..	..	1975	1978	1	
..	..	1978			Aeritalia announced order; re-engined with Rolls-Royce rather than General Electric to circumvent US embargo
150	..	1977	1978	30	Delivery prior to licence production of 120 aircraft
			1979	80	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Spain	4	..	Agosta class	Sub
		4	Bazan	Daphne class	Sub
	UK	18	Short	Seacat	ShAM/ShShM
	USA	1	Bell	Bell-212	Hel
		1	Cessna	Cessna-421C	Trainer
		1	Lockheed	Jetstar-2	Transport
	USSR	12	Tupolev	Tu-22 Blinder-A	Bomber
		2 000	Soviet State Arsenal	T-55	MBT
		400	Soviet State Arsenal	T-62	MBT
		6	Leningrad	Foxtrot class	Sub
				Osa-2 class	FPB
	Yugoslavia	50	Soko	G-2AE Galeb	Trainer/ground attack
13 Madagascar	North Korea	8	Mikoyan	MiG-17	Fighter
	USSR	..	Mikoyan	MiG-21MF	Fighter
10 Malaysia	France	20	Aérospatiale/ Westland	SA-341H Gazelle	Hel
		4	CMN	Perdana class	FPB
	FR Germany	3	Lürssen	PX	FPB
	Israel	..	IAI	Gabriel-2	ShShM
	Italy	5	Agusta	AB-212	Hel
	Sweden	4	Karlskrona	Spica class	FPB
	UK	1	Wessex	Wasp	Hel
		15	GKN Sankey	AT-105	APC
		..	Short	Blowpipe	Port SAM
	USA	5	Bell	Bell-206B	Hel
		16	Sikorsky	S-61A-4 Nuri	Hel
		130	Cadillac Gage	V-150	APC
13 Mauritius	Argentina	6	FMA	IA-58 Pucara	Trainer/COIN
	Canada	2	DeHavilland Can	DHC-5D Buffalo	Transport
	UK	4	Britten-Norman	BN-2A Defender	Transport
14 Mexico	Israel	10	IAI	IAI-201 Arava	Transport
	Switzerland	12	Pilatus	PC-7	Trainer
12 Morocco	France	24	Dassault	Alpha Jet	Trainer
		25	Dassault	Mirage F-1C	Fighter/interc
		25	Dassault	Mirage F-1C	Fighter/interc
		25	Dassault	Mirage F-1C	Fighter/interc
		40	Aérospatiale/ Westland	SA-330L Puma	Hel
		30	Panavia	Tornado ADV	Fighter
		..	Thomson-CSF	Crotale	Landmob SAM
		48	Aérospatiale	MM-38 Exocet	ShShM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1976			Unconfirmed if both Agosta-class and Daphne-class ordered
..	..	1976	1980		
..	..	1976			
..	..	1978			
..	..	1978	1978	1	Sale via private agent despite US embargo
..	..	1978	1978	1	Sale via private agent despite US embargo
..	..	1975	1977	(4)	At least 1 reportedly in service; may use Soviet pilots
			1978	(8)	
..	..	1976	1977	1 000	
			1978	1 000	
..	..	1976	1976	50	
			1977	150	
			1978	200	
..	..	1975	1978	1	Third sub delivered to new base at Benghazi
..	..	1975	1978	3	More expected
..	..	1975	1977	(10)	At least 50 reportedly ordered
			1978	(10)	
..	..	1978	1978	8	On loan; announced in Nov 1978; Korean pilots
..	..	1978	1979		Announced in Nov 1978; pilots training in USSR
..	..	1976	1977	(10)	
			1978	(10)	
..	..	1976			
..	..	1975	1978	3	
..	..	1976	1978	(54)	Expected to arm Jaguar-2-class FPB
..	..	1974	1978	5	
157	..	1976	1979		Crew of 200 training in Sweden; payment: 30% on signing contract, 15% on completion of first keel, 10% on completion of second keel
..	..	1977			
4.0	..	1977			
..	..	1976	1979		For 4 Spica-class FPB: 1 launcher/ship
..	..	1977	1978	5	
..	..	1977	1978	16	Version for Malaysia
..	..	1977	1978	65	
..	..	2000			Order not final, due to funding problems
..	..	1977	1978	2	2 to be leased pending delivery of new aircraft
..	..	1977	1978	4	
..	..	1977	(1978)	10	Licence production planned but no final agreement reached
..	..	1978			Mexico abstained from ordering F-5E due to US export restrictions
..	..	1978			Order confirmed in 1978
..	..	1976	1978	25	For delivery in 1978
..	..	1977	1979	25	For delivery in 1979
..	..	2000			
..	..	1977			
..	..	1978	1979		
..	..	1978			Several batteries recently ordered
..	..	1977			For 4 PR-72 FPB: 4 launchers/ship; order first reported in 1975

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		(300)	Matra	R-550 Magic	AAM
		3	Dubigeon	Batral type	Transport
		3	..	Champlain	PB
		6	CMN Cherbourg	P-32	CPB
		2	SFCN	PR-72	PB
	Italy	6	Agusta	CH-47C	Hel
		..	Agusta	SH-3D Sea King	Hel
	Spain	1	Bazan	F-30 class	Frigate
		4	Bazan	Mod Lazaga type	FPB
	Switzerland	10	FFA	AS-202 Bravo	Trainer
	USA	24	Bell	Bell-209 AH-1J	Hel
		24	Rockwell	OV-10A Bronco	Trainer/COIN
		20	Rockwell	T-2D Buckeye	Trainer
		334	FMC	M-113-A1	ICV
		100	Chrysler	M-48 Patton	MBT
		..	Ford	AIM-9J	AAM
		1 000	Hughes	BGM-71A TOW	ATM
13 Mozambique	Portugal	7	Nord	Noratlas 2501	Transport
	USSR	3	Mil	Mi-8 Hip	Hel
		(30)	Mikoyan	MiG-21MF	Fighter
		(100)	Soviet State Arsenal	T-54	MBT
		(200)	Soviet State Arsenal	T-55	MBT
13 Mauritania	Argentina	..	FMA	IA-58 Pucara	Trainer/COIN
	France	4	Reims	Cessna F-337	Trainer
	Spain	2	Bazan	Barcelo class	PB
	UK	2	Short	Skyvan-3M	Transport
13 Malawi	France	1	Aérospatiale	SA-316B	Hel
		1	Aérospatiale/ Westland	SA-330L Puma	Hel
	FR Germany	4	Dornier	Do-28D-2	
	USSR	2	Antonov	An-24 Coke	Transport
		1	Mil	Mi-8 Hip	Hel
14 Nicaragua	USA	..	Bell	Bell-205 UH-1H	Hel
		1	Douglas	C-47	Transport
13 Nigeria	France	11	Aérospatiale/ Westland	SA-330L Puma	Hel
		(36)	Aérospatiale	MM-38 Exocet	ShShM
		3	CMN Cherbourg	Combattante-3B class	FPB
	FR Germany	1	Blohm/Voss		Frigate
		2	Howaldtswerke	Ro-Ro-1300	LST
		3	Lürssen	S-143	FPB

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1976	1978	(150)	For 50 Mirage F-1C delivered 1978–79
			1979	(150)	
..	..	1975	1977	2	
			1978	1	
..	..		1977	2	
			1978	1	
..	..	1976			New construction programme; first reported as PR-92
..	..	1976			New construction programme
..	..	1978	1980		12 more to be purchased
..	..	2000			
..	..	1977			
..	..	1977			
..	..	1976	1978	10	Number ordered extended from 4 in 1976 to 10 in 1977
100	..	(1978)			US government announced planned sale; total cost: including 24 OV-10A Bronco fighters
100	..	1978			US government vetoed sale
..	..	1976			
..	..	1978			
..	..	1978			
..	..	1978			
..	..	1975	1977	(500)	
..	..		1978	(500)	
..	..	1978	1978	7	
..	..	1978	1978	3	At least 3 in service
..	..	1977	1978	(30)	According to South African intelligence, planes were unloaded in Maputo in Mar 1978
..	..	1978	1978	(100)	Unconfirmed
..	..	1978	1978	(200)	Large number delivered to Beira, according to unconfirmed reports
..	..	1977			Order not final due to funding problems
..	..	1977	1978	4	
..	..	1976	1978	2	
..	..	1977	1978	2	
..	..	1978	1978	1	Reportedly recently delivered
..	..	1978	1978	1	Reportedly recently delivered
..	..	1978	1978	4	
..	..	1978	1978	2	
..	..	1978	1978	1	At least 1 recently delivered
..	..	1977	1978	(5)	
..	..	1977	1978	1	
..	..	1977	1977	2	
			1978	9	
..	..	1977	1980	(36)	For 3 Combattante-3-class FPB; to be delivered 1980
			1980		
102	..	1977	1980		
..	..	1977			
..	..	1977			
..	..	1977	1980		

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Italy	5	Aermacchi	MB-326GB	Trainer/ground attack
		..	Matra/Oto Melara	Otomat-1	ShShM
		15	Intermarine		GB
	Netherlands	3	Fokker-VFW	F-27 MK-500	Transport
	(South Africa	5	Atlas	AM-3C Bosbok	Trainer
	UK	12	Scottish Aviation	Bulldog-120	Trainer
		18	Short	Seacat	ShAM/ShShM
		10	Fairey Marine	Tracker class	FPB
		2	Vosper	Vosper-9	Frigate
	USA	7	Boeing-Vertol	CH-47C Chinook	Hel
8 Oman	France	..	Aérospatiale	MM-38 Exocet	ShShM
	UK	1	Brooke Marine		Support
9 Pakistan	Argentina	400	..	(AMX-13)	LT
	China	24	Shenyang	F-4	Fighter
		5	..	Hainan class	PB
	France	35	Aérospatiale/ Westland	SA-330L Puma	Hel
		2	..	Agosta class	Sub
	UK	16	Westland	SH-3D Sea King	Hel
	USA	30	Cessna	T-37C	Trainer/COIN
		(840)	Ford	AIM-9J	AAM
		..	Hughes	BGM-71A TOW	ATM
		..	Halter Marine		CPB
14 Panama	Brazil	..	EMBRAER	EMB-110	Transport
	Cuba	..	Bell	Bell-209 AH-1	Hel
	UK	1	Short	Skyvan-3M	Transport
	USA	..	..		PB
15 Paraguay	Brazil	10	EMBRAER	EMB-110	Transport
		20	Aerotec	Uirapuru-122A	Trainer/COIN
	USA	6	Cessna	A-37B Dragonfly	Fighter/COIN
15 Peru	France	(36)	Aérospatiale	MM-38 Exocet	ShShM
		3	CMN	Combattante-2	FPB
		6	..	PR-72P	FPB
	FR Germany	2	Howaldtswerke	Type 209	Sub
	Italy	14	Agusta	AB-212	Hel
		..	Agusta	SH-3D Sea King	Hel
		(72)	Selenia	Aspide-1A	AAM
		(48)	Matra/Oto Melara	Otomat-1	ShShM
		2	Contieri Navali	Lupo	Frigate
		2	Riuniti	Maestrale	Frigate

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1978			
..	..	1977	1980		For 3 S-143 FPB
..	..	1978			
..	..	1977	1978	3	
..	..	1978			Believed originated from South African licence production of AM-3C)
..	..	1977	1978	12	
..	..	1975	1978	9	For 2 Vosper MK-9 frigates: 1 triple launcher/ship
			1979	9	
..	..	2000			
..	..	1975	1978	1	
			1979	1	
45.0	..	1977	1978	7	
..	..	1976	1977	(9)	For 7 Brooke Marine FPB: 2 launchers/ship
			1978	(9)	
..	..	1977	1979		
..	..	1977			Unconfirmed order and designation
..	..	1978	1978	24	MiG-17 version, to supplement T-33 trainers
..	..	1976	1976	2	
			1978	3	
..	..	1977			For Army
..	..	1978	1979		Built for South Africa but embargoed Jan 1978
..	..	1977			
..	..	1977	1978	30	On leave from USAF for training
14.0	..	1976	1977	(420)	Being retrofitted on 140 F-6 fighters
			1978	(420)	
..	..	1977			
..	..	1977			Reported building several 78-ft CPBs
..	..	1977			Unconfirmed order
..	..	1977	1978	10	Purchased via Cuba from US stocks left in Viet Nam
..	..	1978	1979	1	
..	..	1978			
..	..	1977			Ordered by President
..	..	1977	1977	8	
			1978	8	
..	..	1978	1978	6	Recent delivery, instead of EMB-326 fighter from Brazil
..	..	1977			For 3 Combattante-2-class FPB
65.0	..	1977			France won FPB order over Israel, due to offer of 10-year credit
..	..	1976			Arms: 1×76 mm Oto Melara cannon; 2×40/70-mm Breda-Bofors cannon; 2×20-mm Oerlikon cannon
..	..	1975			
..	..	1976	1977	2	For 4 Lupo-class and 2 Maestrale-class frigates
			1978	2	
..	..	1977			
..	..	1975	1978	(24)	For 4 Lupo-class frigates
			1979	(48)	
..	..	1974	1978	(12)	For 4 Lupo-class frigates: 2 twin launchers/ship
			1979	(24)	
..	..	1974	1978	1	2 more licence produced in Peru
..	..	1977			2 more licence produced in Peru

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
	Netherlands	1	..		Cruiser
		1	..		Destroyer
	USA	6	Beech	T-34C-1	Trainer
	USSR	23	Mil	Mi-8 Hip	Hel
		36	Sukhoi	Su-22 Fitter-C	Fighter-bomber
		(100)	Soviet State Arsenal	T-55	MBT
		200	Soviet State Arsenal	T-62	MBT
		(72)	..	SSN-2 Styx	ShShM
		12	..	Osa-3 class	FPB
10 Philippines	USA	4	Lockheed	C-130H Hercules	Transport
		35	Vought	F-8H Crusader	Fighter
		6	Grumman	HU-16B Albatross	Fighter/ASW
8 Qatar	Brazil	20	Engesa	EE-11 Urutu	APC
	France	30	Dassault	Mirage F-1C	Fighter/interc
	UK	1	Britten-Norman	BN-2A Defender	Transport
		8	Alvis	Saracen FV-603	APC
	USA	..	Raytheon	MIM-23B Hawk	Landmob SAM
13 Rhodesia	South Africa	..	Atlas	Impala-2	Trainer/COIN
		(25)	Aérospatiale	SA-316B	Hel
		..	Aérospatiale/ Westland	SA-330L Puma	Hel
	(USA)	11	Bell	Bell-205A-1	Hel
8 Saudi Arabia	France	200	Dassault	Mirage-4000	Fighter
		250	Panhard	AML-90	AC
		449	Giat	AMX-10P	AC
		300	Roanne	AMX-30S	MBT
		..	Aérospatiale	MM-40 Exocet	ShShM
		..	Thomson/Matra	Shahine	Landmob SAM
		8		P-32	PB
	FR Germany	..	Rheinstahl	Marder	APC
	Indonesia	40	Nurtanio AC	C-212A	Transport
	Italy	2	Agusta	S-61A-4	Hel
		2	Agusta	SH-3D Sea King	Hel
	Japan	6	Kawasaki	KV-107/2A-4	Hel
	Netherlands	..	Fokker-VFW	F-28 MK-1000	Transport
	USA	200	Bell	Bell-209 AH-1S	Hel
		(2)	Bell	Bell-212	Hel
		1	Boeing	Boeing-747-131	Transport
		17	Lockheed	C-130H Hercules	Transport

Total cost	Unit cost	Year of order	Year of delivery	No. No. delivered	Comments
..	..	1977			From Netherlands Navy: *De Zeven Provincien*; converted to hel carrier, Terrier ShShM returned to USA
..	..	1977	1978	1	From Netherlands Navy: *Holland*
..	..	1977	1977	3	
			1978	3	
..	..	1978			
..	..	1976	1977	18	Credit terms: 10 years at 2.5% interest
			1978	18	
..	..	1977	1978	(10)	
..	..	1978			
..	..	1976			Reportedly on order for new FPB
700	..	1976			Reportedly on order
..	..	1976	1977	2	
			1978	2	
11.7	..	1977	1978	(5)	From USN surplus stocks; 10 to be used for spares and support over 10 years; purchased instead of F-5E fighters
..	..	1975	1977	2	From USAF surplus stocks; purchased via private agent
			1978	4	
..	..	1977			Being fitted with French guns
..	..	1977	1978	(10)	
..	..	1977	1978	1	
..	..	1977	1978	8	Unconfirmed order
..	..	1977			Unconfirmed order
..	..	(1978)	1978	20	Reportedly recently delivered
..	..	(1978)	1978	(25)	Large increase in numbers reportedly in service between 1976 and 1978
..	..	1978	1978	25	Reportedly delivered
..	..	1978	1978	11	Purchased via private agent despite US embargo; civil version of Bell-205; now in service with AF
..	..	2000			Deal believed cancelled, since USA approved sale of F-15A fighters
..	..	1976	1977	(125)	
			1978	(125)	
..	..	1976	1977	200	
			1978	249	
..	..	1975	1977	(100)	Special version of Crotale developed to meet Saudi request
			1978	(100)	
			1979	(100)	
..	..	1978			
..	..	1974	1980		
..	..	1976			
..	..	1977			Unconfirmed order
..	..	1978			Unconfirmed order from Indonesian licence production
..	..	1977	1978	2	For AF VIP use
..	..	1977	1978	2	VIP version
100	..	1977	1978	6	For SAR use
..	..	1977			Delivery unconfirmed; sale may have been vetoed
..	..	1976	1978	(50)	
..	..	1977	1978	(2)	At least 1 delivered
..	..	1977	1978	1	
..	..	1976	1977	7	
			1978	10	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
		60	MDD	F-15A Eagle	Fighter/interc
		20	Northrop	F-5F Tiger-2	Trainer
		15	MDD	TF-15A Eagle	Trainer
		..	FMC	M-113-A1	ICV
		..	Chrysler	M-60-A1	MBT
		..	Cadillac Gage	V-150	APC
		(240)	GD/Raytheon	AIM-7F Sparrow	AAM
		(240)	Ford	AIM-9J	AAM
		400	Koll/MDD/ Raytheon	FGM-77A Dragon	Landmob/port
		(1 200)	Raytheon	MIM-23B Hawk	Landmob SAM
		..	GD	MIM-43A Redeye	SAM
		117	MDD	RGM-84A Harpoon	ShShM
		6	..		Corvette
		12	Halter Marine	..	CPB
		4	Peterson	MSC-322	Coast minesweeper
		9	Tacoma		FPB
13 Senegal	Canada	..	DeHavilland Can	DHC-5D Buffalo	Transport
	France	6	Fokker-VFW	F-27 MK-600	Transport
13 Sierra Leone	FR Germany	1	MBB	Bo-105CB	Light hel
10 Singapore	Australia	4	Lockheed	C-130A Hercules	Transport
	FR Germany	36	..	M-2B	MT
	USA	34	MDD	F-4E Phantom	Fighter
		18	Northrop	F-5E Tiger-2	Trainer
		3	Northrop	F-5F Tiger-2	Trainer
		200	Raytheon	AIM-9L	AAM
13 Somalia	Egypt	..	..	SA-3 Goa	Landmob SAM
	(Thailand)	70	Bell	Bell-206B	Hel
	USA	25	Bell	Bell-209 AH-1G	Hel
		10	Lockheed	C-130H Hercules	Transport
13 South Africa	France	(108)	Aérospatiale	MM-38 Exocet	ShShM
	Israel	(72)	IAI	Gabriel-2	ShShM
		3	Isr. Yard Haifa	Reshef	FPB
	Italy	3	Agusta	AB-212AS	ASW hel
		50	..	M-109-A1	SPH
		400	FMC	M-113-A1	ICV
		..	Selenia	Aspide-1A	AAM
	Japan	1	Mitsubishi		Survey

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
2 500	19.0	1978	1981		Included in US sales package to Middle East, approved in Feb 1978
..	..	1975	1977	6	
			1978	14	
..	..	1978	1981		Included in US sales package to Middle East, approved in Feb 1978
..	..	1976	1977	(50)	
			1978	(50)	
..	..	1976	1977	(10)	
			1978	(10)	
15.0	..	1978			For National Guard
..	..	1978	1981		For 60 F-15A fighters to be delivered from 1981
..	..	1978	1981		For 60 F-15A fighters to be delivered from 1981
26.0	..	1976	1977	(200)	
			1978	(200)	
1 100	..	1976	1978	(400)	6 batteries ordered
..	..	1977	1978	(400)	
..	..	1975	1979		For 6 new corvettes and 6 FPB
..	..	1976	1979		
..	..	1976	1977	9	
..	..		1978	3	
..	..	1975	1978	4	
..	..	1978	1980	9	
..	..	1976			
..	..	1977	1978	4	From surplus stocks
			1979	2	
..	..	1978	1978	1	For Presidential use
..	..	1978	1978	4	From Australian AF surplus stocks
..	..	1978	1978	18	Crew training in FRG
			1979	18	
..	..	1977			
110	..	1976			Total cost: including 3 F-5F trainers
..	..	1976			
..	..	1976			For 21 F-5E/F fighters
..	..	1977	1978	25	According to unconfirmed reports; delivered as MAP during war with Ethiopia
				(250)	
..	..	1977	1977	70	Reportedly purchased via private agent, from US stocks transferred from Viet Nam
..	..	2000			Negotiating
..	..	2000			Negotiating
..	..	1976	1977	(54)	For modernization of 9 aged British destroyers: 4 launchers/ship
			1978	(54)	
..	..	1974	1978	(72)	For 6 Reshef-class FPB: 4 launchers/ship
..	10.0	1974	1978	3	3 more licence-produced in South Africa
..	..	1975	1977	1	For modernized President-class frigates
			1978	2	
..	..	1977	1978	50	Being delivered, according to Gervasi report
..	..	1977	1978	200	Being delivered, according to Gervasi report
..	..	1975	1977	(36)	For modernized President-class frigates
			1978	(36)	
..	..	1976			

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
9 Sri Lanka	France	2	Aérospatiale	SA-365 Dauphin	Hel
	UK	5	Cheverton		PB
13 Sudan	Brazil	6	EMBRAER	EMB-110	Transport
	Canada	4	DeHavilland Can	DHC-5D Buffalo	Transport
	France	24	Dassault	Mirage-50	Fighter
		15	Aérospatiale/ Westland	SA-330L Puma	Hel
		(50)	Giat	AMX-10RC	Recce
	FR Germany	20	MBB	Bo-105C	Hel
	USA	6	Lockheed	C-130E Hercules	Transport
		10	Northrop	F-5E Tiger-2	Trainer
		2	Northrop	F-5F Tiger-2	Trainer
13 Swaziland	Netherlands	1	Fokker-VFW	F-28 MK-3000	Transport
8 Syria	France	40	Aérospatiale	Super Frelon	ASW hel
		..	Euromissile	HOT	Landmob/port
		1 000	Euromissile	Milan	Landmob/port
	France	..	Euromissile	AS-34 Kormoran	Adv AShM
	Italy	18	Agusta	AB-212	Hel
		12	Agusta	SH-3D Sea King	Hel
	(Libya	500	Soviet State Arsenal	T-62	MBT
	Switzerland	16	Farner-Pilatus	MBB-223K	Trainer
	USA	2	Lockheed	L-100-20	Transport
	USSR	10	Mil	(Mi-8 Hip)	Hel
		12	Mikoyan	MiG-27	Fighter/strike
		60	Soviet State Arsenal	T-62	MBT
		..	..	AT-3 Sagger	ATM
		..	..	SA-6 Gainful	Landmob SAM
		..	..	SA-8 Gecko	SAM
		..	..	SA-9 Gaskin	Landmob SAM
10 Taiwan	Israel	50	IAI	Kfir-C2	Fighter-bomber
	Italy	(24)	Matra/Oto Melara	Otomat-1	ShShM
	USA	50	Bell	Bell-205 UH-1H	Hel
		..	Lockheed	F-104S	Fighter
		50	Vought	F-8H Crusader	Fighter
		..	Chrysler	M-48 Patton	MBT
		(288)	Hughes	AGM65A Maverick	ASM
		5	Bethlehem/Bath	Gearing class	Destroyer

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1977	(1978)	(2)	Included in financial agreement of Nov 1977; for AF VIP use
..	..	1977			
..	..	1976	1977	3	
			1978	3	
..	5.0	1977	1977	2	
			1978	2	
..	..	1977	1978	12	Option on 14 more
			1979	12	
..	..	1977	1978	15	
..	..	1977	1978	(50)	
..	..	1977	1977	(10)	According to unofficial reports
			1978	(10)	
74.0	..	1976	1978	6	Total cost: including spares and support
117	..	1978			First requested in 1977; congressional approval received in 1978
..	..	1978			First requested in 1977; congressional approval received in 1978
..	..	1978	1978	1	
..	..	2000			May order 14–40 hel
..	..	1977	1977	48	Euromissile sale; probably funded by Saudi Arabia;
			1978	90	Aérospatiale receives 530 mn francs, MBB receives DM 215 mn
224	..	1977	1978	(500)	Euromissile sale; FRG claims France has sole
			1979	(500)	responsibility for exports
..	..	1977	1979		Euromissile sale
..	..	1976	1978	18	
..	..	1976	1978	12	
2 000	..	1978			MAP)
..	..	1977			
..	..	1976	1978	2	US government approval in Jul 1977
..	..	1978	1978	(10)	Total of 22 Mi-8 in use
..	..		1978	10	
..	..	1978	1978	12	Deal of Jan 1978, including hel, ATM, MBT; funding by Libya
..	..	1977	1978	60	Deal of Jan 1978; funding by Libya
..	..	1978	1978	(1 200)	Deal of Jan 1978; funding by Libya
..	..	1978	1978	(200)	Deal of Jan 1978; funding by Libya
..	..	1977	1978	(200)	Deal of Jan 1978; funding by Libya
..	..	1978	1978	(200)	Deal of Jan 1978; funding by Libya
500	..	2000			Taiwan may still purchase, despite earlier reports of cancellation of deal, since USA vetoed sales of more sophisticated F-4E Phantom fighters
..	..	1976	1977	(12)	For 2 PSMM-5 FPB: 4 launchers/ship
			1978	(12)	
..	..	1976	1977	25	For army
			1978	25	
..	..	2000			Requested from USAF surplus stocks
..	..	2000			Requested from USAF surplus stocks
..	..	1977	1978	(50)	Refurbished
..	..	1978	1979	(288)	US government approved sale; for licence-produced F-5E fighters rather than approving sale of more sophisticated F-4E Phantom fighters
..	..	1976	1977	4	Arms: 3 × Gabriel-2 ShShM being retrofitted
			1978	1	

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
13 Tanzania	Canada	4	DeHavilland Can	DHC-5D Buffalo	Transport
	FR Germany	1	..		Survey
	Italy	2	Agusta	AB-206B-2	Hel
	UK	3	Hawker-Siddeley	HS-748M	Transport
	(USSR	350	Soviet State Arsenal	T-54	MBT
10 Thailand	Canada	2	Canadair	CL-215	Amphibian
	France	(36)	Aérospatiale	MM-38 Exocet	ShShM
	Indonesia	4	Nurtanio	C-212A	Transport
	Italy	3	Breda		FPB
	UK	117	Alvis	Scorpion FV-101	Recce AC
	USA	13	Bell	Bell-205 UH-1H	Hel
		2	Bell	Bell-214B	Hel
		16	Northrop	F-5E Tiger-2	Trainer
		3	Northrop	F-5F Tiger-2	Trainer
		25	Vought	F-8H Crusader	Fighter
		2	Swearingen	Merlin-4A	Lightplane
		6	Rockwell Int	OV-10C Bronco	Trainer/COIN
		18	..	S-58T	Hel
		114	Ford	AIM-9J	AAM
13 Togo	Brazil	3	EMBRAER	EMB-326GB	Trainer/COIN
	France	5	Dassault	Alpha Jet	Trainer
		1	Aérospatiale/MBB	C-160F Transall	Transport
		5	Dassault	Mirage-5	Fighter
		5	Panavia	Tornado ADV	Fighter
12 Tunisia	Austria	40	Steyr-Daimler	Cuirassier	LT
	France	..	Aérospatiale/ Westland	SA-330L Puma	Hel
		1	..	A-69 type	Corvette
	Italy	3	Aeritalia	G-222	Transport
		8	Aermacchi	MB-326K	Trainer
		6	SIAI-Marchetti	SF-260C	Trainer/COIN
	USA	10	Northrop	F-5E Tiger-2	Trainer
		2	Northrop	F-5F Tiger-2	Trainer
		60	FMC	M-113-A1	ICV
		..	..	M-577-A1	Cargo
		..	..	Vulcan	SPG
		(72)	Ford	AIM-9J	AAM
		1 320	Hughes	BGM-71A TOW	ATM
		..	Ford/Raytheon	Chaparral	Landmob SAM
		(72)	Hughes	AGM65A Maverick	ASM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
28.0	..	1977	(1978)	(4)	
..	..	1976	1979	1	
..	..	1977	1978	2	
..	..	1976	1977	2	
			1978	1	
..	..	1977	1978	350	Reportedly supplied for training of Zimbabwe guerrilla in Tanzania)
..	..	1977	1978	2	Pilots and technicians training in Canada
..	..	1976	1979	(36)	For 3 Breda FPB
..	..	1976			Reportedly ordered from Indonesian licence production
85.0	..	1976	1979	3	
17.0	..	1978	1978	117	
10.0	..	1977			Pending congressional approval
..	..	1978	1978	2	Reportedly recently delivered
50.0	..	1976	1978	16	
..	..	1976	1978	3	
..	..	2000			From US Navy surplus stocks; to be used for spares during 10 years
3.0	..	1977	1977	1	
			1978	1	
13.0	..	1977			Pending congressional approval
..	..	1977	1978	18	From US Army stocks in Thailand; converted from H-34 configuration
..	..	1976	1978	114	For F-5A and F-5E fighters
..	..	1978			
..	..	1977	1980	5	
..	..	1978			
..	..	2000			Requested
..	..	1977	1979	5	FRG approval of sales to Africa not needed under Dassault/Dornier agreement of 1972
..	..	1976	1977	20	
			1978	20	
..	..	1977	1978	(2)	At least 1 in use
..	..	1972	1979	1	
..	4.0	1975	1978	3	
..	..	1976	1977	4	
			1978	4	
..	..	1977	1978	6	
..	..	1976			
..	..	1976			
23.3	..	1978			Pending congressional approval; total cost: including BGM-71A TOW ATM and M-577 vehicles
..	..	1978			Pending congressional approval
18.0	..	1978			Pending congressional approval; Vulcan-Chaparral air defence system
..	..	1976			For 12 F-5E/F fighters
23.0	..	1978			Pending congressional approval; including 120 practice missiles; total cost: including M-113-A1 AC and M-577 vehicles
18.0	..	1978			Pending congressional approval; Vulcan-Chaparral air defence system
..	..	1976			For 12 F-5E/F fighters

Region code/ Recipient	Supplier	No. ordered	Manufacturer	Weapon designation	Weapon description
15 Uruguay	Brazil	1	EMBRAER	EMB-110B	Photo survey
	FR Germany	2	Howaldtswerke	Type 209	Sub
15 Venezuela	FR Germany	2	Howaldtswerke	Type 209	Sub
	Italy	..	Selenia	Aspide-1A	AAM
		(72)	Matra/Oto Melara	Otomat-1	ShShM
		6	Riva Trigoso	Lupo	Frigate
	(Sweden	40	Saab-Scania	Saab Supporter	Trainer/ground attack
	USA	12	Beech	T-34C-1	Trainer
10 Viet Nam	USSR	(200)	Soviet State Arsenal	T-62	MBT
		(100)	..	ZSU-23-4 Shilka	SPG
		(2 000)	..	SA-7 Grail	Landmob/port
		(1 000)	..	SSN-2 Styx	ShShM
8 Yemen, Democr.	UK	..	Fairey Marine	Tracker class	FPB
13 Zaire	China	2	SIAI-Marchetti		GB
	France	20	Reims	Cessna F337	Trainer
	Italy	12	..	SF-260M	Trainer
13 Zambia	Italy	18	SIAI-Marchetti	SF-260S	Trainer
	UK	..	Short	Tigercat	SAM

Total cost	Unit cost	Year of order	Year of delivery	No. delivered	Comments
..	..	1978	1978	1	
..	..	1974			
..	..	1977			
..	..	1977	1978	48	For 6 Lupo-class frigates
..	..	1975	1978	24	For 6 Lupo-class frigates: 4 launchers/ship
507	..	1975	1978	2	
..	..	2000			Military visit to Saab in 1978 after sales drive in Latin America may result in order)
..	..	2000			
..	..	1978	1978	(200)	Large number delivered prior to war with Kampuchea
..	..	1978	1978	(100)	Large number delivered prior to war with Kampuchea
..	..	1978	1978	(2 000)	Large number delivered prior to war with Kampuchea
..	..	1978	1978	(1 000)	Coastal defence version
..	..	1976	1978	1	
..	..	1978			
..	..	1977	1978	20	Large number of Cessna types delivered from 1974
..	..	1978			For training and liaison
..	..	1978			
..	..	1978	1978	(100)	Delivered for protection against Rhodesian incursions; designation also reported as Rapier

Appendix 3C

Sources and methods for the world arms production and trade data

This appendix describes the sources and the methods used in the preparation of the SIPRI registers of world arms production (appendices 2A and 2B) and world arms trade (appendices 3A and 3B). The SIPRI data in these registers have been computerized this year, and for this reason a more detailed description of the data, and of the sources and methods used in compiling the data, is given in this appendix.

Chapter 2 describes the trends in 1978 world arms production, and chapter 3 describes these trends for world arms trade.

I. Purpose of the data

Together with the data for world military expenditure (see chapter 1 and appendix 1A), the arms production and arms trade registers form the nucleus of a comprehensive, quantitative and qualitative survey of world armaments. The arms registers show the origin, flow, costs and main characteristics with regard to the technical sophistication of the major weapons now being acquired in all countries.

Countries and time period covered

The arms production registers cover all the major weapons in production or being designed in all countries of the world during the calendar year 1978.

The arms trade registers cover all major weapons on order or delivered to all countries during 1978.

All countries are listed in the registers in alphabetical order; the world region to which each country belongs is indicated in the first column (for the key to the region code, see the conventions and abbreviations, page 255). These regions correspond to those in the military expenditure data series (appendix 1A).

Appendix 2A—arms production in the industrialized countries—contains register I, the indigenous production of major weapons, and register II, the licensed production.

Appendix 2B—arms production in Third World countries—includes register I, the indigenous production, and register II, the licensed production.

Appendices 3A and 3B—the arms trade with industrialized and Third World countries, respectively—list the recipient countries in alphabetical order. Tables 3.1 and 3.2 (pages 170-173) are aggregate tables of the values of arms imports by Third World regions and of exports by supplier countries.

The absence of a country from one or another of the arms production or arms trade registers means that no activity of the type indicated has been found for that country.

II. Definitions and criteria

The arms production and arms trade registers cover the four categories of 'major weapons'—that is, aircraft, armoured vehicles, missiles and warships. Strictly speaking, all of these except missiles are potential 'weapon platforms', while missiles are part of 'weapon systems'. However, our use of the term 'weapon' or 'major weapon' by and large conforms with general practice. The great majority of the aircraft, armoured vehicles and warships entered in the registers are armed; as such, they constitute either the central component of a weapon system which is generally identified by reference to that platform or a major unitary fighting system.

Arms production

In the arms production registers, the criterion for selection of major weapon items is that of military application. However, for reasons of space, some categories have been excluded from these registers, such as aerobatic lightplanes, harbour tugs and icebreakers.

In the licence production registers, major arms produced under contracts are entered, but only when *final assembly* of the weapon takes place in the producing country. This means that in those cases when an arms-purchasing country produces some components for an imported weapon, this is not entered as licensed production but as trade with offset agreements for the local industry.

Arms trade

In the arms trade registers, the criterion for selection of major weapon items is the identity of the buyer—that is, items either destined for or purchased by the armed forces in the buyer country. This means that items listed in the trade registers are not necessarily to be found in the production registers. (For example, the civilian version of the Bell 205 helicopter in use by the Rhodesian Air Force is included in this year's trade register but is not listed under US production in the production register.)

The selection of entries for *aircraft* and *warships* presents no particular problems. If an item is purchased by the armed forces of the recipient country, it is included irrespective of type.

The category *armoured vehicles* includes all types of tanks, armoured cars, armoured personnel carriers, infantry combat vehicles as well as self-propelled guns and howitzers. Military trucks, however, are not included.

The category *missiles* is meant to include only guided missiles, although the distinction between missiles and rockets is sometimes unclear in the reference works used as sources. In principle, unguided rockets are not included.

All types of arms transfer are included—that is, direct sales, military aid, gifts, loans and grants. Weapons for police forces are not included. The entry of any arms transfer is made in accordance with the four-category division of major weapons. This means that when, for example, a missile-armed ship or aircraft is purchased, the missiles are entered separately in the arms trade register.

Dates and numbers

Both the order dates and the delivery dates for the arms transactions are continuously being revised in light of new information. The *order date* should ideally be the date on which the sales contract was signed. However, this information is often not available. Order dates given within parentheses, thus *(1977)*, indicate either an estimated date or a preliminary date of order—for example, the known date of the decision to acquire a weapon. In order to enable the reader to follow the development of any given arms transaction, all the *delivery dates* (that is, not only the items delivered in 1978) are given together with the number of items delivered that year—thus, *1974:10, 1975:25* and so on. Other dates entered thus, *2000,* indicate that an advanced stage of negotiation has been reached and that the order is very likely to be signed in the near future. The year 2000 was arbitrarily chosen as a future date which, for computerization purposes, would indicate the near certainty of a future order of particular interest.

The exact number of weapons ordered as well as number of weapons delivered per year may not always be known and may need to be estimated. Such estimates are also given within parentheses. There are various aids for making these estimates: in the case of aircraft, the size of squadrons is usually known and this provides a relatively reliable basis for estimating the number of a new type of aircraft to be introduced. It is also possible to learn from the information on production of the weapon type in the supplier country how many of a certain type of aircraft can reasonably be expected to be exported in one year.

The numbers of missiles involved in one transaction pose the greatest problem in the arms trade data collection. The information is often limited to the bare fact that a certain missile system has been bought to arm a certain type of aircraft, warship or armoured vehicle. In such cases it is, however, possible to ascertain how many aircraft will be armed with the missile and how many launchers each aircraft has. But for estimating the exact number of missiles, a rule of thumb is used. It is assumed that there are at least three missiles per launcher: thus, if a new air-to-air missile is purchased for 30 fighter aircraft with two launchers per plane, the number of missiles will be 30 x 2 x 3, or 180.

For small ships, such as modern fast patrol boats, the estimate of three missiles per launcher is used. For bigger ships, such as destroyers or frigates, a minimum of 12 missiles per launcher is assumed.

Numbers of surface-to-air missiles are calculated primarily on the basis of the launch platform—if it is a fixed platform, information is usually available on the size and equipment of a battery or an army battalion equipped with missiles.

Numbers of small, anti-tank missiles involved in arms transactions have often been underestimated in previous registers. An average estimate of 20 missiles per launch vehicle is now assumed.

III. The data collection

Reliability

The data in the arms production and trade registers are collected each year from technical, commercial and military publications and journals, as well as from a number of daily newspapers, reference books and other literature. The common criterion for all these sources is that they are published and available to the general public. Thus, for each weapon project listed in the arms production registers and for each arms transfer listed in the trade registers, there is a wide variety of sources of information. The data and the sources are stored in the computer storage system and can be displayed on request.

Before publishing the data, judgement on the reliability of the various sources must first be made. As a rule, reports from one single source are not considered reliable enough; ideally, a minimum of five independent sources is required for a reliable report on one item of data.

The greatest difficulty is, however, not ascertaining the reliability of the data which are published and available, but rather the 'missing data'. Experience with this data collection has shown that, in time, all arms transactions are reported in the published literature; but it often takes a number of years before enough such reports appear so that, for instance, the information on arms transfers for 1978 is not sufficiently complete until 1980.

The data

The data presently being computer-stored are the following.

(*a*) For the *arms production file*: the weapon category, weapon designation, country of weapon design, technical data on weight and speed of the weapon, the time span for a weapon development project, the numbers of weapon planned for actual production, the weapon production rate, and the accompanying equipment including standard armaments, power plant, radar and so on.

For licensed production: the year of licence and the terms of the licence agreement as well as the stage of licensed production, ranging from assembly of subassemblies to complete manufacture from raw-material stage.

For indigenous and licensed production: the current unit sales price, the R&D cost, the SIPRI value estimate (either for new, second-hand or refurbished weapons), the source for the SIPRI value estimate, and information on comparable weapons where relevant (see further the section on the SIPRI statistics, below).

(*b*) For the *arms trade file*: the buyer, weapon category, weapon designation, date of order and number ordered, seller, buyer, seller organization (for example, army, air force, navy, government, private, commercial or illegal), actual total sales cost, unit sales cost plus date of information, status of the weapon (new, second-hand or refurbished), accompanying equipment (armaments, power plant and so on), coverage of the deal (including spares, training, support equipment, technical equipment), terms of the deal (cash, credit, gift, military aid, loan, licensed production), and delivery years and numbers.

For each entry, the source is noted.

In future, when the computer storage is completed for all countries from 1946 to the present, this information will be retrievable according to various commands, resulting in other combinations of data to enable a fuller and more detailed analysis of the various aspects of arms production and trade to be made.

IV. The value of the arms trade

The SIPRI statistics

The SIPRI system for evaluating the arms trade was designed as a trend-measuring device, to enable the measurement of changes in the total flow of major weapons and its geographic pattern. Put into monetary terms, this heterogeneous flow reflects both the quantity and the quality of the weapons transferred.

SIPRI independently evaluated the arms trade by constructing a list of comparable prices in 1968 dollars, based on such actual prices as were known at that time and on such criteria as weight, speed and role of the weapon. These criteria differ for each category of weapon. (The choice of base year is due to the fact that the SIPRI arms data collection was begun in 1968, at a time when very little published information was available on the prices of weapons.)

The monetary values chosen do not, therefore, necessarily correspond to the actual prices paid, which vary considerably depending on different pricing methods, the length of production runs, and the terms involved in individual transactions—the actual sales price for a given weapon system differs according to the buyer and the coverage of the deal. For instance, a deal may or may not cover spare parts, training, support equipment, compensation and offset arrangements for the local industries in the buying country, and so on.

Furthermore, to use only actual sales prices—assuming that the information were available for all deals, which it is not—military aid and grants would be excluded, and the total flow of arms would therefore not be measured.

The 'pricing' of new weapons developed after 1968 is based on information from various producers on the so-called ex-factory unit cost or 'fly-away' unit cost for Western weapons. For weapons for which all price information is lacking, a comparison is made with a known weapon of the same type as regards performance criteria, and the weapon is valued accordingly. The final check of the reliability of this performance comparison is made by a military panel on which all the armed services are represented.

One effect of this valuation system is, of course, that the values for Soviet weapons, for example, *never* correspond to actual prices paid. These are generally lower or are not paid in monetary units.

However, this valuation system has proven to serve well the purpose for which it was designed, particularly in the absence of other reliable national or international statistics on the flow of arms. The individual 'prices' are less essential to this valuation system than two other main considerations, namely, that the method of pricing is applied with utter consistency, and that the more sophisticated weapons are always valued higher than the less sophisticated ones.

The SIPRI price list

The original price list, based on constant 1968 US dollars, was first inflated to reflect 1973 price levels and then to reflect 1975 price levels. The method used to obtain the factor needed was to construct a weighted index, using only three countries—the USA (60), the UK (20) and France (20)—as the major Western arms-exporting countries, and the wholesale consumer price index for the same countries. The factor arrived at for the 1973 values was 1.3 and for 1975, 1.7.

This method may in future be revised, considering the inflation problem and other related problems. For example, we are now considering using the export of engineering equipment rather than the wholesale consumer price index. SIPRI solicits views and proposals from consultants and other researchers in this field, and would also like to receive such views from its general readership.

Each weapon obtains three separate values—new, second-hand or refurbished. The variations among the four weapon categories are as follows.

Aircraft

For new aircraft, a percentage is added to the basic 'price' for spares in different subcategories: 40 per cent for combat aircraft, 25 per cent for trainers and transports, and 50 per cent for helicopters. After 1975, the cost escalation of the same aircraft with no major modification has been found to be some 10 per cent per year, which is a combination of the increase in technical improvement and inflation.

Refurbished aircraft are valued at 50 per cent of the basic price plus full value of spares.

Second-hand aircraft are valued at 10 per cent of the basic price plus full value of spares.

Missiles equipping an aircraft are valued separately.

Other armaments, such as machine-guns, bombs, rockets, napalm and so on, are so far not being valued.

Armoured vehicles

Refurbished vehicles are valued at 100 per cent of the basic value, and *second-hand* vehicles at 50 per cent of the basic value. No addition is made for spare parts.

Missiles

Missiles are only valued as *new*, with no addition for spare parts.

The launch equipment is valued separately, since it may vary with each transaction, comprising, for example, launch vehicles, radar vehicles, and command and control equipment. The launch equipment is in general not included in the arms trade registers, since the missile entries are intended to represent the entire system. In value terms, however, the launch equipment is more expensive by far than the single missile.

Warships

For warships, it was possible to construct a more standardized valuation system. The ships were divided into 11 categories depending on the tonnage. For each category a 1968 dollar price *per tonne* was calculated, based on actual prices in 1968. One result is that a small but technologically sophisticated ship such as a missile-equipped fast patrol boat automatically receives a higher price in relation to a large but 'unsophisticated' ship such as a tanker, since the price per tonne is of course higher per small unit.

Further, we assumed a technical improvement factor of 3.5 per cent per year. This improvement factor has nothing to do with general price inflation. It is merely intended to measure the increase in the sophistication of ships. According to military experts, there may be reason to change this to 5 per cent during the 1970s. The practical result for the time being is that a ship sold in 1978 is 3.5 per cent more expensive than a ship of the same class sold in 1977.

The 'lifetime' of ships, as compared with that for other weapon categories, is very long, often at least 25 years. A large proportion of ships sold have been second-hand. It was therefore necessary to take into account the depreciation of ship values. A simple exponential depreciation was taken, based on the length of life of ships in each of the 11 categories and a scrap value of 1 per cent.

In practice, this means that the value of a ship delivered in 1978 but completed in 1958 is calculated in the following way: the price per tonne in 1958 is found, and the depreciation rate for the class of ships in question is then used to calculate the depreciated tonne price, multiplied by the displacement in tonnes, thus giving the new price.

For *refurbished* ships, the method of calculating is as in the following example: a ship completed in 1940 is refurbished in 1960, and then it is sold in 1970. The age of this ship is calculated as (20/2) + 10, or 20 years rather than 30 years.

The scrap value of ships is 20 per cent of the original value at completion date.

Licensed production

For licensed production, an attempt was first made to calculate the imported content of the locally produced weapon (with a percentage of indigenization of, for example, 75 per cent, then 25 per cent of the basic value should be counted). However, this information is very scarce, and when the percentage was not known, it was assumed to be 100 per cent, as the foreign exchange cost involved in producing major arms under licence is often as high as the cost of importing the weapon. By now, all licence-produced weapons are valued at 100 per cent—that is, the same as the cost of importing the weapon, in the absence of better information. The assumption is, however, that a more correct estimate might range between 150 and 200 per cent, at least in some cases, in particular in the Third World. In other cases, for example in Europe, the cost might actually be 25–50 per cent of the imported weapon, depending on the level of technology and the existence of the necessary infrastructure and related industries.

When a country first produces a weapon under licence (for example, US helicopters produced in Italy), this transaction is first calculated as Italian import from the USA. When Italy then exports these helicopters, for example to Iran, this is calculated again, as Iranian import.

In such cases the same weapons are thus calculated twice, which has been found to be a better reflection of the actual transfer of military technology and arms than other methods.

It can safely be assumed that the transfer of technology is not free of charge but very little is known about actual sums paid in connection with licensing agreements. Normally, a licence contract has its price, and after that a certain 'royalty' is paid for each weapon produced.

The trade statistics are now computer-calculated. The procedure is to connect the trade file with the production file: from the trade file the delivery year 1978 is chosen, plus the weapon designation and the information on status (new, second-hand or refurbished). The SIPRI value is taken from the production file. The tables are summarized by using the Third World and Industrialized World code and then the region codes for the different countries.

The individual 'worksheets', showing the values for each country as both exporter and importer, broken down by weapon category and supplier/recipient, will shortly be made available on request. However, as some readers may already have experienced, it is very difficult for SIPRI to provide this service until our computer storage programme is complete. For technical reasons, world-wide series will not be available in worksheet format before then. Requests for worksheets for single countries can still be met. The manually completed worksheets only go up to 1976, since values from 1977 are computer-calculated.

Finally, we should like to point out that number codes have not been used for the computer storage system. This means that the registers and various listings can be read easily, with a minimum amount of decoding instructions—for example, a three-letter country code is used, a six-letter source code and a 15-letter weapon description code.

V. The SIPRI sources

As in the case of the sources for the military expenditure data (see appendix 1B, section V, page 62), the sources for the world arms production and arms trade data are of five general types and are available to the general public. However, for the arms registers, comparatively few books or monographs are used since the information there is generally too dated. An exception is annual reference works which contain periodically updated material.

The fact that different sources may give conflicting information on the same item necessitates an evaluation of the reliability of all the sources before the item is entered in the arms *trade* registers in particular (see also the section on reliability, above). In future a reliability index of the most frequently used sources will be made by mathematically weighting the sources used in compiling the SIPRI data.

The total number of sources perused for relevant data is at present 162. In addition to many of those sources listed in appendix 1B (page 62), the following are a selection of first-priority sources for arms production and trade data.

Journals and periodicals

Aerospace International (Bonn-Duisdorf)
Antimilitarismus Information (Frankfurt)
Armament Data Sheets (London, Aviation Studies Atlantic)
Aviation and Marine International (Zurich)
Aviation Week and Space Technology (New York)
Campaign against Arms Trade, Newsletter (London)
Défense Interarmées (Neuilly, France)
Defense Monitor (Washington)
Défense Nationale (Paris)
Forces Armées Françaises (Paris)
Government Business Worldwide Reports (Washington)

Interavia Airletter (Geneva)
Interavia Data (Geneva)
International Affairs (London)
International Air Forces and Military Aircraft Directory (Stapleford, UK, Aviation Advisory Services)
Military Review (US Army Command and General Staff College)
Missiles and Rockets (Washington)
NACLA's Latin America & Empire Report (New York)
Österreichische Militärische Zeitschrift (Vienna)
Official Price List (London, Aviation Studies Atlantic)
Soldat und Technik (Frankfurt)
US Naval Institute Proceedings (Annapolis, Md.)
Wehrtechnik (Bonn-Duisdorf)
3. Welt Magazin (Bonn)

Annual reference publications

'Aerospace Forecast and Inventory', annually in *Aviation Week and Space Technology* (McGraw-Hill, New York)
Defense and Foreign Affairs Handbook (Copley & Associates, Washington)
International Air Forces and Military Aircraft Directory (Stapleford, UK, Aviation Advisory Services)
Jane's All the World's Aircraft (Macdonald & Co., London)
Jane's Fighting Ships (Macdonald & Co., London)
Jane's Infantry Weapons (Macdonald & Co., London)
Jane's Weapon Systems (Macdonald & Co., London)
Jane's World Armoured Fighting Vehicles, C. F. Foss (Macdonald & Co., London)
'Military Aircraft of the World' and 'Missile Forces of the World', annually in *Flight International* (IPC Transport Press, London)

VI. Conventions and abbreviations

The following conventions and abbreviations are used in the registers of world armaments data:

Conventions

. .	Information not available
( )	Uncertain data or SIPRI estimate
2000	An imminent future date

Abbreviations and acronyms

AAM	=	Air-to-air missile
AAV	=	Anti-aircraft vehicle
AC	=	Armoured car
ACM	=	Anti-cruise-missile missile
ADV	=	Advanced defence version
AEV	=	Armoured engineering vehicle
AEW	=	Airborne early warning system aircraft
AF	=	Air force
AFV	=	Armoured fighting vehicle
Aircr	=	Aircraft
Amph	=	Amphibious vehicle/amphibian aircraft
APC	=	Armoured personnel carrier
ARM	=	Anti-radar missile
ARV	=	Armoured recovery vehicle
AShM	=	Air-to-ship missile
ASM	=	Air-to-surface missile
ASuM	=	Air-to-submarine missile
ASW	=	Anti-submarine warfare
ATM	=	Antitank missile
BLT	=	Bridge-laying tank
Cann	=	Cannon
Cargo	=	Cargo vehicle
CIWS	=	Close-in weapon system (on ship)
CM	=	Cruise missile
COIN	=	Counterinsurgency
CPB	=	Coastal patrol boat
CRV	=	Commando-recce vehicle
D	=	Diesel
DE	=	Diesel electric
ECM	=	Electronic countermeasures
ELINT	=	Electronic intelligence
Fleet Repl	=	Fleet replenishment ship
FPB	=	Fast patrol boat
FROG	=	Free rocket over ground
FY	=	Fiscal year

GB	=	Gun boat
GT	=	Gas turbine
Guid	=	Guidance system
HE	=	High explosive
Hel	=	Helicopter
ICBM	=	Intercontinental ballistic missile
ICV	=	Infantry combat vehicle
IDS	=	Interdiction/strike version
Interc	=	Interceptor
L	=	Liquid
Landmob	=	Landmobile (missiles)
LASSO	=	Light air-to-surface semi-automatic optical
LC	=	Landing craft
LP	=	Liquid propellant
LS	=	Landing ship
LSH	=	Heavy-lift ship
LST	=	Tank landing ship
LT	=	Light tank
LVA	=	Assault landing vehicle
MAP	=	Military assistance programme (US)
Mar patrol	=	Maritime patrol aircraft
MBT	=	Main battle tank
MCM	=	Mine countermeasures
MG	=	Machine-gun
MICV	=	Mechanized infantry combat vehicle
Mort	=	Mortar
MT	=	Medium tank
NAP	=	Napalm tanks
NBMS	=	Nuclear-powered ballistic missile submarine
NCMS	=	Nuclear-powered cruise-missile submarine
Nucl or N	=	Nuclear
P	=	Power plant
PB	=	Patrol boat
PI	=	Piston
Port	=	Portable
RAD	=	Radar
Recce	=	Reconnaissance (aircraft or vehicle)

RL	=	Rocket launcher
Rock	=	Rocket
S	=	Solid
SAM	=	Surface-to-air missile
SAR	=	Search and rescue
SC	=	Scout car
ShAM	=	Ship-to-air missile
ShSh(M)	=	Ship-to-ship missile
ShSu(M)	=	Ship-to-submarine missile
SL	=	Storable liquid
SLBM	=	Submarine-launched ballistic missile
Son	=	Sonar
SPG	=	Self-propelled gun
SPH	=	Self-propelled howitzer
SShM	=	Surface-to-ship missile (coastal defence missile)
SSM	=	Surface-to-surface missile
ST	=	Steam turbine
SuAM	=	Submarine-to-aircraft missile
Sub	=	Submarine
Support	=	Fleet support ship
Survey	=	Survey/research ship
SuSh(M)	=	Submarine-to-ship missile
SuSu(M)	=	Submarine-to-submarine missile
TB	=	Torpedo boat
TD	=	Tank destroyer
TF	=	Turbofan
TJ	=	Turbojet
TP	=	Turboprop
Transport	=	Cargo/transport ship or aircraft
TS	=	Turboshaft
TT	=	Torpedo tube

Region codes

1	USA	9	South Asia
2	USSR	10	Far East
3	China	11	Oceania
4	NATO, excl. USA	12	North Africa
5	WTO, excl. USSR	13	Sub-Saharan Africa
6	Other Europe, Eastern[1]	14	Central America
7	Other Europe, Western[1]	15	South America
8	Middle East	16	International

[1] Regions 6 and 7 are given together as one region in the military expenditure data.

4. The military use of outer space

Square-bracketed numbers, thus [1], refer to the list of references on page 303.

I. Introduction

Attention was once more focused on various military activities in outer space by several events in 1978. At the beginning of the year, control was lost over a Soviet military satellite carrying a nuclear reactor. Although several US satellites carrying nuclear power sources have also crashed-landed, it was Cosmos 954 which received greatest publicity. It plunged into the Earth's atmosphere and landed on 24 January 1978. Part of the Earth's surface and, possibly, the atmosphere were contaminated with radioactive materials from the spacecraft's nuclear reactor.

A number of such ocean-surveillance satellites have been launched by the USSR to observe ocean surface targets such as military ships. The USA has also launched ocean-surveillance satellites, but they probably do not carry nuclear power sources. Such satellites are also used to measure various ocean properties, such as temperature, salinity and wave dimension. The transmission of sound generated by submarines, for example, is partly dependent upon the first two of these factors. To a varying extent waves on the surface of the sea add to the general background noise of the ocean. A knowledge of these factors is essential to the better design of sensors used on and below the ocean surface for the detection of submarines.

President Carter officially acknowledged, on 3 October 1978, that the USA has been using artificial Earth satellites to observe and photograph from low orbits certain activities on the surface of the Earth. A few months earlier, during the United Nations Special Session on Disarmament, the French President had suggested that a UN arms control agency be established. One of the functions of such an agency would be to serve as a clearing-house for military information gathered by artificial Earth satellites of various nations. In this connection it has been indicated that any satellite that France may develop and launch for Earth observations would be put at the disposal of the UN agency.

The USA and the USSR began talks in June 1978 on the control of their anti-satellite (ASAT) activities. Both powers have been working on various methods of destroying satellites in orbit. This has focused attention on the possible development of new weapons such as high-energy lasers (HEL) and charged or neutral particle-beam weapons (PBW). The feasibility of these weapons is being studied initially for anti-satellite purposes. Other uses are also envisaged, however, such as the land-based anti-ballistic missile system.

US and Soviet ASAT activities are discussed in the following sections, with particular emphasis on the possible development of high-energy beam weapons. Studies of possible ground-based laser weapons are reviewed. A brief assessment of the capabilities of ocean-surveillance satellites is made, with descriptions of the US and Soviet programmes.

Military dependence on artificial Earth satellites (112 satellites were launched in 1978) is increasing considerably. Various military missions carried out by satellites have been described in some detail elsewhere [1]. It is apparent from the list of military satellites given in tables 4.1 to 4.17 that these activities are still going on.

II. Anti-satellite activities

Dependence on military satellites has grown. Artificial Earth satellites have been launched equipped with sensors suitable for the observation of targets, the navigation of missiles, ships, and submarines, for related weather forecasting, for early warning of an attack, and for the control and command of forces. They will soon be capable of guiding bombers to targets. As the effective role of satellites for waging war on Earth has grown, increasing attention has been given to the development of means by which to counter and destroy them.

In March 1977 the USA invited the USSR to form a joint group to discuss the control of ASAT activities. Their first meeting took place in June 1978 in Helsinki, and the second on 23 January 1979 in Bern.

A number of methods are being investigated for disabling an enemy satellite, ranging from ground-based anti-satellite missiles to orbiting killer-satellites. Some methods have already been tested. Some of the ASAT systems, and the US and Soviet programmes, are briefly reviewed below.

Conventional ASAT systems

The early ASAT system in the USA was an Earth-based one. It used missiles based at Johnston and Kwajalein Islands in the Pacific Ocean. This and other early systems are described more fully elsewhere [1, 2]. The current US programme contains three separate projects, each investigating different techniques [3]. No details of these, or their progress, are known. It is known, however, that under the $58.7 million contract of the US Air Force (USAF) two types of killer-satellite system are being investigated. In one—a direct ascent system—a cylinder, 45 cm long and about 30 cm in diameter, would be launched from a high-speed aircraft flying at high altitude. The cylinder would contain a non-nuclear warhead which would be separated close to the target and guided to it by an infra-red homing device. Another approach being developed within this project is a non-explosive one in which a small manoeuvrable vehicle, carrying an infra-red sensor for guidance, would ram and destroy an enemy satellite. A number of such vehicles would be carried into Earth orbit by a rocket which would dispense them near a target satellite.

The second US killer-satellite project is similar to that developed by the USSR. Either a killer-satellite would be put in the same orbit as the target and then manoeuvred towards it, or else it would be put into a different orbit but given a fast approach to the target satellite. The USSR has conducted several tests of this nature. In the USA, the design was well under way by 1978. Such a killer-satellite would weigh some 300–700 kg, and three of them would be built initially. The killer-satellite is designed to approach the target, guided by radar, and then explode to destroy the target.

A related project involves the construction of a target vehicle to carry instruments to assess the performance of the above-mentioned mechanisms for satellite destruction as well as to assist the ground tracking system.

High-energy beam systems

It is, however, development of the type of ASAT technology involved in the advanced systems project which has recently raised considerable debate. This involves the development of high-energy beam weapons. Both the USA and the USSR are actively exploring the use of high-energy laser and charged or neutral particle beams as weapons. In the USA, the following possible applications of these weapons are under discussion: (*a*) for surface-to-air, air-to-air and space-based ballistic-missile defence; (*b*) for ship-borne anti-missile weapons; (*c*) for air-to-air weapons; and (*d*) for satellite-borne anti-satellite killer systems.

There is no evidence that either the USA or the USSR has armed its satellites with laser or particle-beam weapons. However, initial results indicate that laser weapons now appear to be feasible. It has been reported that it may even be possible to choose whether to use light radiation, electrons, protons, neutral particles or heavy ions [4]. History has shown that whenever technology has offered mankind the slightest possibility of a new weapon, the opportunity to turn the possibility into a reality has been seized although such weapons seem expensive and even difficult to use initially. At this stage, therefore, it would be useful to consider how much effort the two powers are presently giving to this technology.

High-energy lasers

The USSR and the USA have been interested in laser (Light Amplification by Stimulated Emission of Radiation) technology for roughly the same period of time. Scientists from both nations shared the Nobel prize for the discovery of the laser some two decades ago. The theoretical idea of a laser was proposed by Schawlow and Townes from the USA and Basov and Prokhorov from the USSR in 1958. However, lasers powerful enough for weapon applications have until now not been demonstrated, at least not in the USA.

There are basically three types of laser which are considered by the military to be potential candidates for weapon application. These are the chemical laser, the electric discharge laser (EDL) and the gas dynamic laser (GDL):

1. In the chemical laser, exothermic chemical reactions produce direct internal excitation of the atoms and molecules of the reacting substances. Under favourable conditions, the density of these excited particles may be high enough to result in an inversion, and may thus be exploited for laser action. Chemical lasers are compact.
2. In the EDL the lasing material is excited by collisions with the electrons of an electric discharge, sometimes in combination with an external high-voltage and electron beam. Carbon monoxide or carbon dioxide are usually used as the lasing material in high-power applications.
3. In the GDL the atoms and molecules achieve a state of excitation by heating, and the necessary inversion is subsequently produced by rapid expansion of the hot gas through small supersonic nozzles. The gas is usually a mixture of carbon dioxide, nitrogen and water vapour. The GDL is the oldest of the genuine high-energy lasers. Nowadays it is only marginally interesting, however, because of its low efficiency.

The main characteristics of these lasers are summarized in table 4.18.

Target damage mechanisms. A laser beam may damage a target by thermal weakening, shock-wave propagation and UV or X-ray radiation, or a combination of these processes. In the thermal weakening process, the temperature of the target-surface is raised sufficiently to soften and even melt or vaporize the surface. When a short pulse of high-energy laser radiation impinges on the surface of a material, it causes a very rapid and substantial increase in the temperature of a thin layer of the target. The surface layer vaporizes and 'explodes', moving away from the target at high speed. A shock wave is propagated into the target and may tear it apart. Materials which are poor conductors of heat are particularly vulnerable to this type of damage. Finally, the vaporized surface may emit a large amount of radiation in the form of UV radiation or X-rays. This may cause structural damage both to the target material and to the electronic components which the target may contain. Table 4.19 shows the energy required to thermally damage some common materials.

Problems to be solved. There are a number of problems still to be solved before high-energy lasers can become practicable weapons. For example, the question of tracking and aiming at a fast-moving target is not completely solved. Efforts are being made to overcome this difficulty, however, and to some extent success has already been achieved. Another problem is that of developing optical components suitable for use in a high-energy laser system. These problems are more of a technical and engineering nature and will no doubt be solved in time.

Nature also presents certain difficulties. Beam energy, for example, is reduced by molecular absorption and scattering in the atmosphere. In addition, the beam spreads and, because of atmospheric turbulence and refractive index fluctuations along the beam path, does not travel in a straight line. Moreover, the air through which the laser beam travels is heated by radiation energy which, in itself, changes the refractive index of the air. Under certain circumstances as much as 90 per cent of the target radiation intensity is lost in this way. This is known as thermal blooming. A technique is being developed in which controlled distortion of the beam is introduced at the source to compensate for its spread, due to both turbulence and blooming. The blooming can also be reduced by pulsing the laser output. The last of the atmospheric effects is electrical breakdown of the air through which the beam is travelling. This phenomenon generates a plasma which absorbs the laser energy and effectively shields the target from the beam. This effect occurs, at least in air, at power density levels of several megawatts per square centimetre. The effect also depends on the pulse duration, so that the energy at which plasma is formed can be considerably increased by reducing the pulse duration.

Finally, as mentioned above, when a continuous laser beam falls on a target, heat is produced and a cloud of vaporized material and plasma of ionized air is generated. At beam intensities up to about 10 MW/cm^2, the plasma boundary moves away from the target at subsonic speed and absorbs the beam energy. The effect is to screen the target from the laser beam. At beam intensities of about 100 MW/cm^2, the plasma boundary propagates back up the laser beam at supersonic speed, thus resembling a detonation wave and also completely cutting off the beam. It should be noted that it is exactly these mechanisms which are also responsible for the above-mentioned UV or X-ray radiation. They may, therefore, result in a net enhancement of the radiation–target coupling instead of a cut-off under certain circumstances.

Many of these problems either become simpler to overcome or even cease to exist when high-energy lasers are used in outer space. Nevertheless intensive research is under way to solve these problems to enable such weapons to be used on Earth.

Current programmes. Since ground-based ASAT systems are also envisaged, it is useful to consider briefly the development of ground-based beam weapons. Research on HEL weapons has been highly classified almost from the outset. In the USA, the work began under the code-name of Eighth Card. A glimpse of the programme was obtained when it was reported in 1972 that a gas dynamic laser with a power of 60 kW was used to set fire to wooden planks placed at a distance of some two kilometres and, at that stage, accuracy was sufficient to make a hole in a mobile target 6 cm x 10 cm in size [5].

In mid-1975, in the USA, the Special Laser Technology Development Program (SLTDP) was established. In the two years which followed, the Defense Advanced Research Projects Agency (DARPA) and the three armed services made coordinated efforts to demonstrate the feasibility of developing HEL weapons [6]. The role of DARPA was twofold: firstly it was to develop the basic technology required to evaluate the feasibility of HEL weapons and, secondly, it was to look at the possible application of these in space defence. For this programme, particular emphasis was put on the development of chemical lasers [4].

The first part of the programme included investigations of beam control, pointing and tracking and fire control systems as well as basic studies of the propagation of laser energy and its effects on targets and vulnerabilities [4]. DARPA also concentrated on the development and demonstration of laser technology for both space-based infra-red hydrogen fluoride chemical lasers and ground-based electrically excited lasers in the visible range of the spectrum. The former laser, emitting energy of wavelength around 2.7 micrometres (μm), is the most promising device because of its high power output for a given weight of the system as a whole. Useful efficiencies were demonstrated in 1978 in a small laser, and the problems of scaling up the system will be tackled during 1979. High levels of energy have been produced from electrically excited excimer-type lasers.[1] For example, energies in the single-pulse beam of such a laser have been increased from one joule to over 350 joules. However, considering the absorption and the beam dispersion, much larger energies are needed to damage a target (table 4.19). The wavelength of light from such lasers is in the visible and ultra-violet regions. Such lasers promise considerable advantages since they may impose less stringent conditions on optical systems and have, potentially, better transmission and focusing properties.

All three services have programmes at an advanced stage. The US Army supported the broad HEL technology development programme, as well as research on laser vulnerability, and established the Army Mobile Test Unit (MTU). This consists of a 1–15 kW laser mounted on an amphibious landing vehicle [7]. The Army conducted some lethality tests using this electric-discharge carbon dioxide continuous-wave laser. Two further programmes are being pursued by the Army, involving helicopter-mounted and infantry-mounted laser weapons. These are probably medium-energy level lasers [7]. In 1976, one US Army high-energy laser shot down a remotely piloted vehicle from the ground [8]. At present the Army is cooperating closely with the US Navy in its development of lasers [9].

The Unified Navy Field Test Program, originally called the Land Based Test Program, consisted of research into various chemical lasers. The Navy has also been obtaining data on propagation over the ocean surface from laser experiments on weather ships in the Atlantic and Pacific Oceans. Of the various chemical lasers, the Navy has selected a deuterium fluoride laser for its laser demonstration programme. In 1978 such a laser operating at a wavelength of 3.8 μm destroyed a high-speed BGM-71A TOW anti-tank missile [10].

The US Air Force has established its Airborne Laser Laboratory (ALL) using a Boeing KC-135 aircraft. Initially a medium-power electric-discharge carbon dioxide laser was used in a feasibility study. Experiments were conducted with this system to measure laser intensity and dispersion using a second KC-135 aircraft carrying measuring instruments. Problems such as distortion of the laser beam while passing through disturbed air, and the stabilization of the beam, were also investigated. It was found that these factors were not as serious as first thought. The ALL now carries a high-power GDL system [10]. This laser is expected to be tested against drone targets during 1979. Work on a modified deuterium fluoride laser began in 1977 under the project code name Sigma.

[1] A compound is known as a dimer if its molecules are formed by the addition of two molecules of a simpler compound. Some molecules of dimers exist only when one or both of their constituent elements is in an excited state. Such dimers are known as excited-dimers or excimers. The excited molecule gives up its energy in the form of laser radiation.

The Department of Defense (DoD) HEL funding is shown in table 4.20.

If lasers are to be used as weapons, high energies are needed so as to ensure useful lethal ranges. High-power sources are needed to achieve this end. The question of the initial energy, therefore, is also of considerable importance, particularly for the types of military application considered here. Some power sources useful for laser weapons are given in table 4.21.

So far only the US military HEL programme has been discussed. Little information is available about Soviet efforts towards military applications of HEL. However, from their scientific publications on laser technology in general, no difference in level of scientific knowledge on the subject is apparent between the USA and the USSR. Moreover, according to the statement made by Dr John L. Allen (the Deputy Director of US Defense Research and Engineering) in testimony given in the US Senate Committee on Armed Services, the USSR has several major experimental installations and appears to have programmes for land, sea and space applications [4]. It has recently been reported that the USSR is preparing to test a space-borne hydrogen fluoride HEL designed for ASAT applications [11].

Particle-beam weapons

A possible PBW could be made up of beams of charged or neutral particles of high energies used to damage a target. These could be electrons, protons, heavy ions or neutral particles. The high energies of such beams could be obtained in either circular or linear accelerators, or a combination of both.

There are basically two types of particle-beam accelerator. In the first, a high voltage of the order of 1 GV (or more) and a low current (in the milliampere range) are used. In the second, lower voltages with currents in the kiloampere range are used. It is the latter type, particularly those which accelerate heavy ions, which are relevant to the present discussion on PBWs. These technologies are also important in nuclear fusion research, and in nuclear weapon simulation experiments.

Energies of particles from accelerators have increased by a factor of 10 every seven years for the past three decades [12]. Particle beams have so far been used in research on fundamental physics and the work has been carried out on an unclassified basis in many countries.

On the military side, the US DoD has reported that it is exploring the potential use of particle-beam technology for a number of possible different applications including a satellite-borne ASAT weapon, a ballistic missile defence, a shipboard anti-missile system and an air-to-air weapon [12]. Like the high-energy laser, particle beams could destroy a target with explosive energy deposition as well as thermal effects. A high-intensity beam would be needed for such processes to take place. In contrast to laser radiation, particle beams penetrate the target and cause interior damage.

In the USA, DARPA and all three services are involved in the PBW research [11, 12]. There is a move to improve the coordination of the US PBW programme. Various tasks will be assigned to the different armed forces.

Experimental particle-beam programmes were established in mid-1974 [13]. The US Air Force exploratory development programme at Kirtland special weapon centre is continuing its work on collective accelerators. The accelerator giving a low-energy (several MeV) and high-current (megampere) beam of electrons will be converted to one which will produce an ion beam of very high kinetic energy with moderate current, to test the atmospheric propagation properties of charged particles [14]. The US Air Force is also working on the concept of a neutral-beam accelerator for use in space. In cooperation with the US Army, the Air Force is also conducting research on PBWs under the Army's Sipapu programme. The Army Ballistic Missile Defense Command, under the Sipapu programme at Los Alamos Scientific Laboratory, is concentrating on basic physics experiments and the development of some components. The Army's main interest in this technology is ballistic missile defence.

The main effort in the USA, however, in terms of investment in PBW research, is a Navy project called Chair Heritage. This programme is aimed to establish a particle-beam technology for Navy applications. However, it was recently recommended that the responsibility for this, and other defence programmes on high-energy beam weapons, was to be given to DARPA. The Advanced Test Accelerator (ATA), which can produce a beam of 50 MeV and an expected beam current of 10 kilo-amperes, is being constructed. The experimental test accelerator now in operation produces 5 MeV beams. Experiments on electron propagation over short distances are being carried out with the ATA.

A basic part of the programme is high pulse-power technology which is directed towards the development of power sources which can produce very large pulses of energy during a short emission time. These power sources will also be suitable for the pumping, that is optical inversion, of electrically excited lasers to generate intense microwave radiation. Such power sources store energy at relatively slow rates and then release it at a much faster rate. This technology is rapidly expanding. Methods of current interest are inductive, that is magnetic, energy storage, and explosive techniques for electric current-switching and pulse-forming networks to increase the power. Small prime power sources will, therefore, be able to deliver the very high peak power levels required for beam weapons.

The seriousness with which the USA is taking its PBW programme was indicated by the formation of a group of 36 physicists and engineers in 1978. The group is to produce a plan for a centrally directed US particle-beam weapons programme [14]. For example, the physics of propagation will be investigated by the Navy, using electrons. The Army and the Air Force will study the use of protons, and the Army will investigate neutral particle beams. As for accelerator technology, the Navy will develop ATA, the advanced autoaccelerator, a new continuous-pulse accelerator, and the recirculating Linac device; the Army will complete the development and testing of the autoresonant accelerator and an ion accelerator; and the US Air Force is to investigate the radial-pulsed linear accelerator.

The DoD funding for the PBW programmes is shown in table 4.22, the US and Soviet high-current electron accelerators are listed in table 4.23, and heavy ion accelerators in table 4.24.

As far as the Soviet PBW programme is concerned, a series of articles during 1977 and 1978 in *Aviation Week and Space Technology* have claimed that the USSR is not only highly advanced in PBW technology but has even, on eight occasions, successfully tested the propagation of electron beams in the ionosphere and in outer space. Later experiments were carried out from Cosmos unmanned satellites and from the Salyut manned space station [14]. It is true that Soviet research is in the lead in certain fields of accelerator technology, such as the concept of collective effect and the use of the electron ring. Indeed, these concepts originated in the USSR [1]. It is unlikely, however, that they have reached a stage at which they could test a PBW based on satellites.

Conclusions

Both the USSR and the USA are developing, or have already developed, a number of relatively simple satellite destruction mechanisms. These use either conventional explosives carried by the interceptor or the interceptor itself to destroy a target satellite. In addition, high-energy beam weapons are being investigated for their potential use as ASAT systems. High-energy lasers are attractive not only because they deliver destructive energy with the speed of light, but also because they have a high fire-power potential per weapon. They could be switched rapidly from one target to another and immediately sense and rectify any error in aiming.

While there are several atmospheric beam propagation problems to be overcome as far as the Earth-bound HEL weapons are concerned, there is little doubt that satellite-based HEL weapons could be deployed in about a decade or so.

The potentials of PBWs are being investigated for much the same types of application as HEL weapons. Like lasers, neutral particle beams could be suitable for use in outer space. Recently the feasibility and value of particle beams as weapons have been doubted, mainly on the grounds of the difficulties in tracking a target and aiming the beam accurately [15, 16]. Nevertheless the potential advantages of such weapons could be considerable. It is, therefore, difficult to imagine that military technologists would not be exploring it fully, even in the face of many uncertainties. In the USA, all three armed services are spending relatively large sums of money on studies of these technologies. Moreover, the results of the Chair Heritage programme, for example, on the propagation properties of such beams through the atmosphere, seem to indicate that transmission may not be such a great problem [14]. For example, an electron beam pulsed for 10 nanoseconds with an interval between pulses of 10–15 microseconds could be used up to a range, in the atmosphere, of a few kilometres [17].

Ion beam accelerators, particularly the collective accelerators, have not yet reached a comparable potential. In them, the heavy ions are embedded in a ring of electrons. Being much lighter, the latter can be accelerated with relative ease. The ions will remain trapped by coulomb forces and be carried along with the electron ring. While the electrons gain energy (for example a few MeV), the trapped ions will become many thousand times more energetic since their rest mass is orders of magnitude larger than that of the electrons. It should also be remembered that central parts of the basic technology required for the beam weapons have already been explored and will continue to be developed for fusion technology applications.

In view of the efforts devoted to high-energy weapons, their possible development for military uses in outer space cannot be ruled out. Possible political difficulties and some possible technological problems, at least for the near future, have prompted a plea for a treaty banning any ASAT system [9]. Talks on banning ASAT systems have begun between the USA and the USSR. If such a ban is agreed upon, a positive step in itself, this may well encourage and proliferate the use of military satellites. Although these limited steps are in the right direction, it has been suggested that perhaps the time is ripe for bilateral or multilateral agreements banning the military use of outer space and ensuring that only peaceful use takes place [18–21].

III. Ocean-surveillance satellites

Ocean-surveillance satellites have three functions. First, they are used to determine departures of the ocean surface from the geoid. Second, they measure wave heights, ocean currents, surface temperatures, wind speeds and coastal features, in order to improve maps and charts for navigation. Third, these satellites are used to detect and track surface ships. Although this can now be done relatively easily, the problem of identification remains. To some extent this is overcome by monitoring from a satellite electronic signals transmitted by surface ships. All these tasks are performed by sensors such as long-range radars, microwave and infra-red radiometers, radar altimeters, photographic and television imaging sensors and microwave scatterometers aboard satellites.

In the following sections the capabilities of some of these sensors and the ocean-surveillance satellite programmes of the USSR and the USA are briefly reviewed.

Sensor technology

Two types of radiometer are used for measuring temperatures and ocean images—infra-red radiometers and microwave radiometers.

The infra-red radiometer

An infra-red radiometer is basically a very sensitive thermometer designed to respond to electromagnetic radiation of wavelengths between 8 and 13 μm emitted from the surface of the sea. At these wavelengths, a considerable amount of radiation is transmitted by the Earth's atmosphere. Moreover, there is very little interference from the scattered radiation. The sensor can either be fixed or be made to scan at right angles to the orbital path of the satellite. The output from the sensor can be displayed either in digital form or in the scanning mode so that the result resembles a photograph. The scan rate is synchronized with the speed of the satellite. Such infra-red images can show the temperature gradients along the surface of the ocean together with ocean currents and eddies.

Infra-red radiometers with high resolutions have been used, for example, aboard the US weather satellites Nimbus 1 and 2. The field of vision of these instruments was about 0.5 degrees with a resolution of about 9 km at an altitude of some 1 000 km. The recent US ocean-surveillance satellite, Seasat A, launched on 12 June 1978 (table 4.4) has an infra-red radiometer to provide ocean surface images and coastal features from an altitude of about 800 km with a resolution of 4 km over a 1 500 km swath [22]. However, the spacecraft experienced some problems and ceased to transmit data on 9 October 1978.

The microwave radiometer

A microwave radiometer is used to measure the sea surface temperature under all weather conditions. The sensor aboard Seasat A (table 4.4), for example, measured ocean surface temperature with an accuracy of 1 °C and, by determining the brightness of the foam, ocean surface wind speed of up to 50 m/s can be determined [22]. The sensor also provided data for atmospheric corrections to the satellite's active radars by measuring liquid and water-vapour content in the atmosphere. The observations were made over a surface area 650 km wide beneath the satellite.

The radar altimeter

The unevenness of the surface of the sea owing to the presence of waves is well known. Less well-known variations are the bumps and dips created by gravity and the configuration of the ocean floor. These fluctuations in sea level are measured by radar altimeters aboard ocean-surveillance satellites. Such an instrument measures the distance between the satellite and the sea surface immediately beneath it by determining the time required for the radar pulse generated by the altimeter to travel from the antenna to the sea surface and back. With this technique, subtle variations caused by wind stress, ocean depth and atmospheric pressure gradients can be measured. However, from the military point of view, the important measurements are those of the large variations in the elevation of the sea surface caused by local gravity anomalies. From these measurements local changes in the strength of the gravitational field can be determined. Knowledge of variations in the gravitational field is essential for submarine activities.

Modern radar altimeters can measure the height of ocean surface waves to within 0.5 and 1 m. Differences between the ocean surface and the geoid as small as 10 cm can be measured [22]. (For a more detailed description of the application of radar altimeters, see chapter 8.)

The scanning radar scatterometer

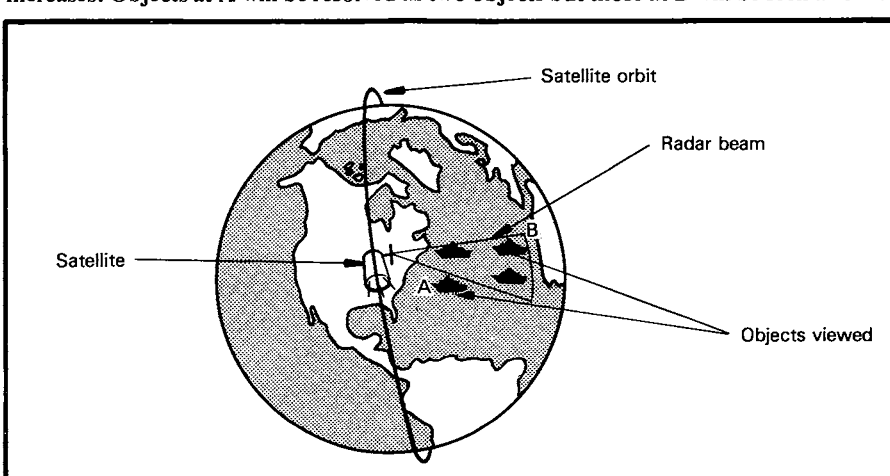
If a beam of radar energy is directed at the surface of the sea, the reflected energy is strong near the vertical if the surface of the sea is smooth, and weak at large oblique angles. However, if the sea surface is rough, then the reflected radar signal weakens near the vertical and increases at large angles. This phenomenon has been used to successfully determine the state of the ocean surface using a so-called radar scatterometer.

Knowledge of the state of the sea could, therefore, be improved in order to allow small vessels to be detected by radar. Since small-scale irregularities on the wave surface are produced by local winds, wind speed and direction could also be determined by the use of a radar scatterometer. Wind speeds between 3–25 m/s could be measured and wind direction could be determined to within 20 degrees [22]. The area covered by a scatterometer aboard the Seasat A satellite was a swath more than 1 000 km wide, covering 95 per cent of the surface of the Earth every 36 hours.

The synthetic aperture radar

One of the most important instruments aboard the Seasat A satellite, for example, is a synthetic aperture radar. In a side-looking radar, the resolution of the radar deteriorates as the distance between the antenna and the objects increases. This is because the radar beam fans out so that the beam is wider at greater distances (see figure 4.1). Moreover, resolution is proportional to beam width. Thus two objects at the same range separated by a distance less than the beam width will not be resolved. The angular width of the beam generated by the radar antenna is inversely proportional to the length of the antenna. The resolution could therefore be improved by using a longer antenna. However, the size of the antenna which can be carried by a satellite is limited, thus limiting the resolution of a side-looking radar.

Figure 4.1. Effect on resolution as the distance between the objects viewed and the radar increases. Objects at A will be resolved as two objects but those at B will be seen as one.



This problem is overcome by a synthetic aperture radar. This is a side-looking radar with a relatively short antenna which is made to behave like a very long antenna with a narrow beam. A long antenna can be synthesized by taking advantage of the motion of the satellite in its orbit. As the satellite progresses along its orbit, the short antenna of its radar transmits pulses of radiation at regular intervals towards the Earth. As the satellite approaches an object on the Earth, for example, the beam of the antenna falls upon, moves across, and finally leaves the object. During this time it reflects the microwave pulses received from the radar antenna back to the antenna. As seen from figure 4.1, the greater the distance between the object and the antenna, the longer the object remains in the beam. Seen from the object, therefore, the radar antenna appears much larger than it is and this apparent length will depend on the distance between the object and the real antenna.

The effective length of the antenna is, therefore, proportional to the range of the object. Since resolution is proportional to the length of the antenna, but inversely proportional to the range, the two effects compensate for each other in a synthetic aperture radar and the resolution of the image remains almost the same at all ranges. High-resolution images of the Earth's surface can thus be obtained from great distances.

Such a synthetic aperture radar aboard the Seasat A satellite was capable of covering a 100-km swath. The radar provided all-weather photographs of ocean waves and ice fields. It detected icebergs, ice leads (openings in sea ice) and ships and other objects longer than 25 m [22]. The radar employed a 2.1 × 10.7 m deployable planar antenna which provided data in real time when the satellite was within the line of sight of a receiving station on Earth. The images could be transmitted at a rate of 110 megabits per second [22].

Nuclear power sources

On 24 January 1978, the Soviet ocean-surveillance satellite, Cosmos 954, entered the Earth's atmosphere and partially burnt up. The remaining debris landed in northern Canada. The satellite was carrying a nuclear reactor to provide power for the radar, and probably for other equipment. Considerable interest in nuclear power sources for use in satellites has recently been generated, since Cosmos 954 was the second satellite which had contaminated the atmosphere and the Earth's surface with radioactive materials. It is, therefore, useful to consider briefly the extent to which such power sources are being used, particularly aboard military satellites.

The amount of power needed in various types of equipment aboard ocean-surveillance satellites is shown in table 4.25. In most satellites the power is generated by solar cells. However, many such cells have to be used and concern has recently been expressed because such a power source becomes vulnerable to nuclear or beam weapon attack. In order to make military satellites capable of surviving nuclear attack, and possible attack from hunter-killer satellites, therefore, considerable impetus was given to the development of nuclear power generators.

The two most commonly used nuclear energy sources are the energy released when a radionuclide decays, and the energy released when a fissile atom fissions. In the first instance the energy source contains a highly radioactive substance, whereas the second generates a number of highly radioactive substances during operation.

In the USA, such compact nuclear power generators are described under the general title of Systems for Nuclear Auxiliary Power (SNAP). The SNAP devices using radionuclides were assigned odd numbers and those employing nuclear reactors were given even numbers. However, SNAP number designations are no longer given to new devices.

The heat produced by decaying radionuclides can be converted into electricity in two ways: (*a*) by dynamic conversion using a turbogenerator, or (*b*) by static conversion which uses mainly thermoelectric devices.

Of more than 1 300 available radionuclides, only eight have characteristics suitable for use as power device fuels. The important characteristics are half-life, power density, gamma-ray emission, physical and manufacturing properties and cost. The most commonly used radionuclide is plutonium-238, an alpha-emitter with a half-life of 87.8 years. It is produced in a reactor either by neutron irradiation of neptunium-237 or by producing curium-242 which decays into plutonium-238 by emitting alpha-rays. In the centre of the typical radionuclide thermoelectric generator (RTG), there is a thick cylindrical fuel capsule which serves as the heat source. Surrounding the fuel capsule are thermoelectric energy converters. Such power sources have been used on several satellites and space probes by the USA (table 4.26). The power output has varied from 2 to about 65 watts.

A US Navy satellite launched on 21 April 1964 carried SNAP-9A RTG. It failed to orbit, however, and the payload re-entered the Earth's atmosphere in the Southern Hemisphere. The Pu-238 content was 17 kCi or about 1 kg. The RTG was completely burned up during re-entry and the resulting radioactive particles were distributed at about 50 km above the Earth's surface. The radioactivity from this source was measurable until the end of 1970 and some 95 per cent of the Pu-238 from SNAP-9A was deposited on the surface of the Earth [23].

As can be seen from table 4.26, RTGs do not produce high power levels. Equipment aboard modern satellites needs power in the region of a few kilowatts (table 4.25). Compact nuclear reactors have been developed to generate such high power levels. The US SNAP-10A, launched into orbit on 3 April 1965, used a reactor consisting of uranium–zironium fuel elements surrounded by a beryllium reflector. The heat from the reactor was removed by liquid sodium–potassium coolant circulating within the reactor core. The uranium used was enriched to about 93 per cent uranium-235 and the electrical power generated was about 600 watts. The reactor produced 42 kW of thermal power.

In the USSR, the US SNAP-1 type of RTGs have been used on two communications satellites [24]. SNAP-1 used cerium-144, a beta-emitter with a half-life of 290 days. The heat produced was used to drive a small turboelectric generator to produce electricity. However, this project was abandoned in favour of a thermoelectric conversion system called SNAP-1A. Two groups of five satellites were launched by the USSR on 3 September 1965 and 18 September 1965. One satellite in each of these groups carried a SNAP-1 type of nuclear power source. The Lunokhod Moon spacecraft also carried radionuclide power generators.

As for reactor-type nuclear power sources, it had been speculated for some time that Soviet ocean-surveillance satellites carry such power generators. The proof of this was provided by the Cosmos 954 accident, and it has been reported that the reactor of the satellite was fuelled with about 50 kg of highly enriched uranium [25].

The US programme

The efficient use of naval weapons, either on the surface of the ocean or below it, is dependent upon detection and location of targets. The systems used for surveillance of targets below the surface of the ocean depend on a knowledge of the physical and chemical state of the ocean. Information about the effects of ocean salinity, and the ocean current on the transmission of sound over long ranges, for example, is essential in the design of long-range sonar systems for the detection of submarines. The design and use of over-the-horizon radar systems require accurate knowledge of the atmospheric conditions above the ocean surface and the state of the ocean surface. In the USA such data have, among other means, been provided by various satellites.

The US Navy's interest in the problems of ocean surveillance dates from 1965. The Air Force has since joined in the programme. Surveillance from space by the US Navy is carried out mostly by means of an ocean-surveillance satellite system using available technology and some advanced sensor systems developed for use aboard satellites. Data gathered from space can then be relayed via communications satellites to land bases. The main aim is to provide almost real-time ocean surveillance.

In the initial stages, the data collected by the US Air Force reconnaissance satellites have been used for comparison with those obtained from naval satellites. Moreover, some of the data collected by civilian satellites have also been used by the Navy. Sea surface temperatures, for example, have been measured using the Nimbus weather satellites, and the state of the sea has been determined by the Tiros weather satellites [26]. The manned flights have also contributed considerably to the field of oceanography. On 9 April 1975, a Geodynamic Experiment Ocean Satellite (GEOS-C) was launched at an altitude of about 850 km. A radar altimeter was placed aboard the satellite to measure wave heights in the sea and the state of major ocean current systems. The instrument measured ocean surface heights with an accuracy of five metres [27].

A newer and more accurate radar altimeter was installed aboard the recent Seasat A ocean-monitoring satellite, an experimental satellite. The satellite was launched on 27 June 1978 in near-circular orbit at an altitude of about 800 km. The satellite was equipped with a multi-frequency microwave radiometer to measure, among other parameters, sea surface temperature and wind speed; a radar scatterometer to measure sea surface effects (which can be used to determine wind speeds and direction); a radar altimeter to monitor wave heights; and a synthetic aperture radar to provide all-weather high-resolution photographs of ocean waves, ice fields, icebergs, coastal features and, of course, ships on the ocean surface.

The US Navy's first ocean-surveillance satellite, designed to monitor locations of surface ships, was built under the code-name White Cloud and launched on 30 April 1976. It was designed to monitor surface ships and carried three small sub-satellites which were placed into near-circular orbits similar to that of the parent satellite. The basic technology of using several satellites to monitor electronic signals generated by naval vessels, and to determine the direction of ships, was demonstrated in 1971 by the launching of multiple satellites (see table 4.4). The satellite contains a number of sensors, including passive infra-red and microwave radiometers and radio-frequency antennas for detecting shipborne radars and communications signals. Each of the three sub-satellites is believed to carry an infra-red and a microwave sensor so that, together with the main satellite, it is possible to cover a large part of the ocean surface.

The Navy launched a second ocean-surveillance satellite on 8 December 1977. As in the case of the previous White Cloud satellite, the main satellite is accompanied by a constellation of three sub-satellites. It is suggested that both these groups of satellites are being used to determine the precise location of surface ships [28]. The telemetry indicates the transmission of large amounts of information such as radar pulses [28]. These White Cloud satellites monitor communications and radar transmission from surface ships and submarines. The satellites can detect signals from a range of some 3 000 km. They are positioned 3 000 km apart to allow continuous monitoring of naval vessels [29]. Under the Clipper Bow programme, advanced ocean-surveillance systems, consisting of radars, will be built for the accurate determination of the positions of surface naval vessels. The full-scale engineering development is expected to begin in 1979. The first launching with such sensors will be in about 1983 [30]. With the electronic signals monitored by the White Cloud satellites and the information from the Clipper Bow satellites, a ship could then be identified.

The Soviet programme

The USSR probably began its ocean-surveillance programme from space in 1967 when the first research and development satellite, Cosmos 195, was launched from Tyuratam on 27 December. After only 21 orbits, the satellite was moved from its low altitude of 250 km to a higher perigee of about 900 km [31]. This type of manoeuvre has characterized most of the Soviet ocean-surveillance satellite operations. The next test satellite, Cosmos 209, remained in low orbit for six days before manoeuvring to high altitude. In subsequent operational satellites, the period for which such satellites remained in low-altitude orbit increased to a maximum of 74 days for Cosmos 654, which was launched on 17 May 1974.

The true nature of these satellites was discovered in 1974, and the reasons for manoeuvres such as those described above is now clear. These ocean-surveillance satellites are equipped with radar systems. Radar systems require large power sources. The Cosmos 954 accident in January 1978 has now shown such a power source to be a nuclear reactor. This would then explain, to some extent, the reason for changing the orbits of the satellites from low- to high-altitude ones. At high altitudes the satellites will remain in orbit for some 500 years, a sufficient time for the short-lived radioactive fission products generated within the reactor to decay. When the satellites return to Earth, however, there will still be some long-lived radioactive materials in the reactor of the satellite, including some of the unburned highly-enriched uranium-235 reactor fuel.

The launchings of the Cosmos 198 and 209 satellites might be considered as the first phase of the Soviet ocean-surveillance satellites. Cosmos 367, 402, 516, and 626 belong to the second phase during which the interval between the launch of each satellite is nearly constant. The exception is the period of 495 days between Cosmos 516 and 626. It is possible that a satellite was launched some 250 days after Cosmos 516 but that it was unsuccessful [31].

Since 1974 two satellites have been launched each year, with the exception of 1975 when one extra satellite, Cosmos 785, was launched. This latter satellite may have been a failure. Satellites in each pair have been launched at a maximum of five days from each other. Moreover, Cosmos 651 and 654 were in the same orbital plane, about 25 minutes apart. This suggests that the satellites operate in pairs [31].

The time difference between Cosmos 723 and 724 in their orbits (about 27 minutes) was similar to that between Cosmos 651 and 654, but the orbital planes differed by about 23 degrees. By about the middle of May 1975, the time difference between Cosmos 723 and 724 was reduced to zero and, at about that time, Cosmos 723 was placed in its higher parking orbit. This suggests that this time difference is important to the operation of the satellites in pairs [30]. It is interesting to note that the USA uses ocean-surveillance satellites in a somewhat similar manner. Four satellites are used at a time by the USA. Satellites in such a group are separated from each other in time and distance along their orbital paths, their orbits being in the same plane. The use of such pairs (90 degrees apart) indicates that they are probably used to determine the position and velocity of the naval vessels being surveyed.

Figure 4.2. The perigee and the apogee heights of Cosmos 954 between 17 September 1977 and 24 January 1978, when the remains of the satellite landed in northern Canada

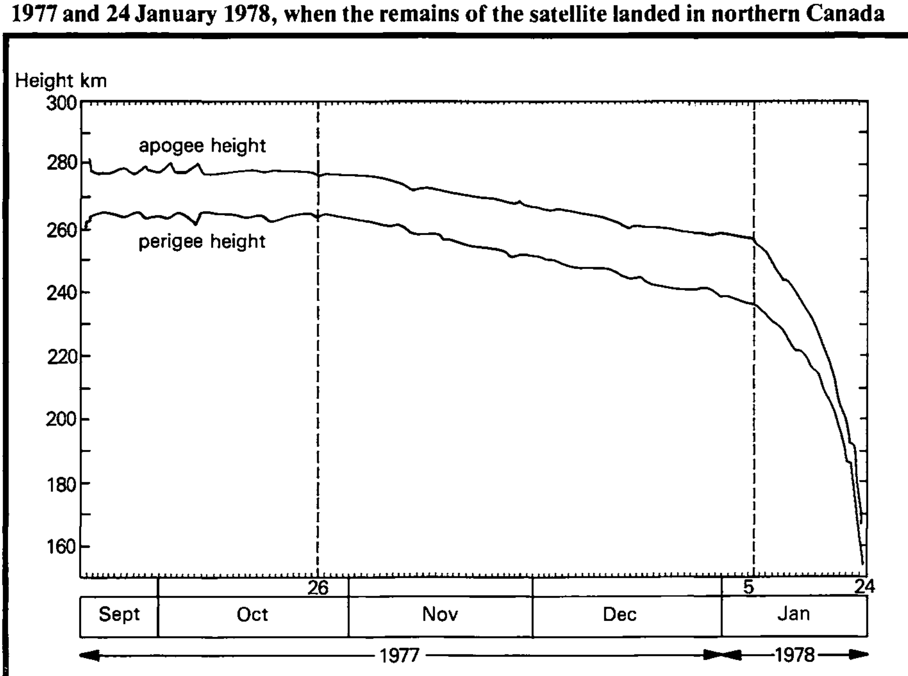
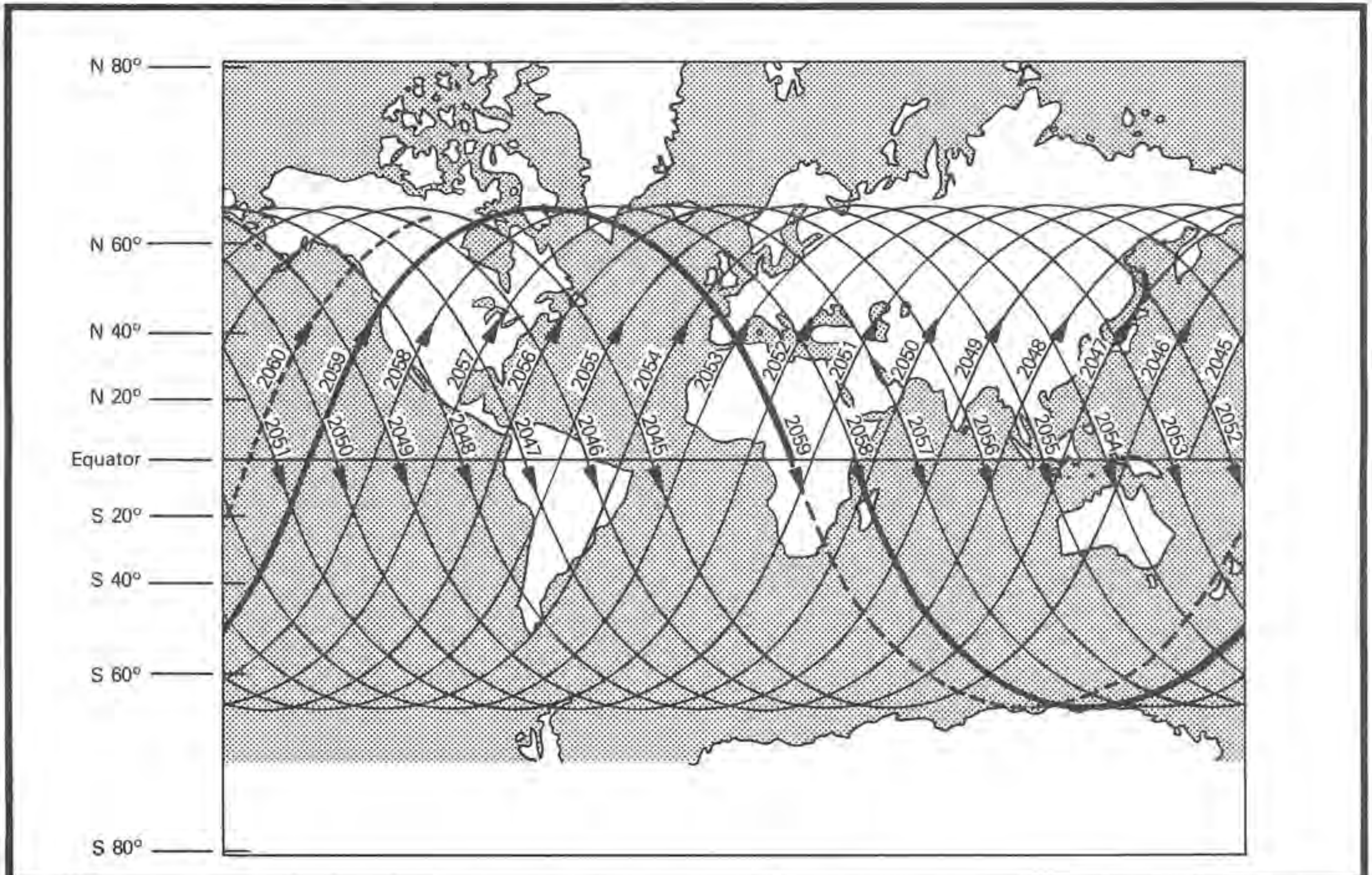
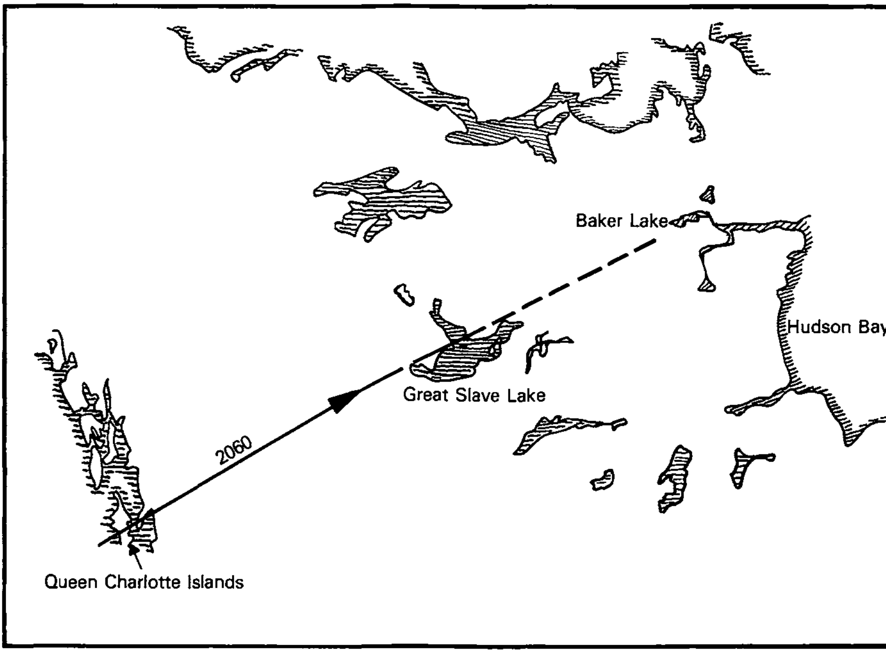


Figure 4.3. Ground tracks corresponding to the last fifteen orbits of Cosmos 954



Note: The satellite's debris landed in northern Canada during the 2060th orbit. Numbers on the ground tracks are orbit numbers. The dotted line indicates the normal ground track on approach to the crash area.

Figure 4.4. The re-entry ground track of Cosmos 954 before its debris landed in northern Canada[a]



[a] The number on the ground track is the orbit number.

Satellites launched in 1976, Cosmos 860 and 861, were orbited in the same orbital plane. The orbits of Cosmos 952 and 954, launched on 16 and 18 September 1977 respectively, were also co-planar and their time difference in the orbit was about 27 minutes. On 8 October the orbit of Cosmos 952 was raised to some 900 km.

From figure 4.2 it can be seen that from about 26 October Cosmos 954 had stopped making any manoeuvres in order to remain in orbit. In fact it had begun the course of natural decay. However, this pattern suddenly changed on 6 January 1978 (figure 4.2) when the satellite began to come rapidly down to Earth and, as can be seen, it landed on the Earth's surface on 24 January, bringing with it the radioactive parts of the satellite's reactor. In figure 4.3 the last few ground tracks of the failed Cosmos 954 satellite are shown. During track 2060 the satellite's unburned parts fell on Canadian soil (figure 4.4).

It has been suggested that, in addition to using satellites carrying radars, the USSR also uses spacecraft with television or electronic signal monitoring sensors [32]. The first of this type of satellite, Cosmos 699, appears to have been orbited on 12 December 1974. One of the reasons for considering that this type of satellite performs ocean-surveillance tasks is that Cosmos 699 and Cosmos 777 were observed to be testing microthrusters, which manoeuvred the satellites for station-keeping in a manner similar to Cosmos 723 and 724 [31, 32]. The latter satellites carried radars for ocean-surveillance purposes. Moreover, the satellites in this new group also transmitted on 166 MHz, a frequency used by the radar-carrying ocean-surveillance satellites.

Conclusions

It can be seen that both the USA and the USSR have several satellites concentrating on ocean-surveillance tasks. It is also apparent that a considerable amount of ocean-surveillance data is generated by other types of satellite, such as weather and photographic reconnaissance satellites. The implications of this development to anti-submarine warfare are discussed separately in chapter 8.

As a result of the Cosmos 954 accident, the United Nations has agreed to begin a technical study on the future of nuclear power systems aboard satellites. The results of the study will be examined by the UN Space Committee in June 1979 and the recommendations discussed in the UN General Assembly. Both the USA and the USSR have agreed to participate in the technical study. There may be some difficulties raised by this study since, ideally, all types of nuclear power source have to be discussed and their use controlled. The USA, however, differentiates between a nuclear reactor and an RTG. The science and technology subcommittee will meet in February 1979 to formulate the study group which will analyse the questions of nuclear power systems aboard satellites.

The type of questions likely to be discussed will concern the altitude at which satellites should be allowed to use nuclear power sources aboard; when notification, if any, should be given of the launch and malfunction in orbit of such a satellite; and whether RTGs and reactors should be treated differently.

In 1978, President Carter stated the USA's willingness to ban the use of nuclear power sources aboard satellites. Such a ban would, however, hamper the use of certain military satellites only.

IV. Tables

Conventions

. .	Information not available
–	None, not applicable

Abbreviations and acronyms

US launchers:

A	Atlas
A-D	Agena-D
Bu II	Burner II
T-3B	Titan-3B
T-3C	Titan-3C
T-3D	Titan-3D
Th	Thor

Soviet launchers:

A-2	Vostok up-rated second stage
A-2-e	One and one-half stage booster with second-generation stage plus escape stage
C-1	Skean intermediate-range missile plus upper stage
D-1-e	Proton booster plus upper and escape stages
F-1-m	SS-9 Scarp missile with orbital and manoeuvrable stages

US launch sites:

ETR	Eastern Test Range (Cape Kennedy, Florida)
WTR	Western Test Range (Vandenberg AFB, California)

Soviet launch sites:

PL	Plesetsk
TT	Tyuratam

Other:

DSCS	Defense Satellite Communications System
GOES	Geostationary Operational Environmental Satellite
NASA	National Aeronautics & Space Administration
NOSS	Navy Ocean Surveillance Satellite
USAF	US Air Force
USAr	US Army
USN	US Navy

Table 4.1. US photographic reconnaissance satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (days)	Whether capsule recovered	Comments
USAF (1978-29A)	WTR T-3D	16 Mar 1843	96.43	88.52	160	240	179	..	Big Bird satellite; carries several capsules which are periodically ejected from the satellite
USAF (1978-60A)	WTR T-3D	14 Jun 1829	96.96	91.90	223	509	..	..	Big Bird satellite; it has been reported that this may be the second of the new generation of KH-11 satellites; the first was launched in December 1976 (1976-125A) and it is still in orbit after two years

[a] The designation of each satellite is recognized internationally and is given by the World Warning Agency on behalf of the Committee on Space Research.

Table 4.2. US electronic reconnaissance satellite launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comment
USAF (1978-29B)	WTR T-3D	16 Mar 1843	95.83	97.59	639	645	60	Launched from Big Bird satellite (1978-29A)

[a] See footnote *a* to table 4.1.

Table 4.3. US early-warning satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
USAF (1978-38A)	ETR A/A-D	8 Apr 0043	–	–	–	–	$> 10^6$	Synchronous orbit similar to 1977-114A
USAF (1978-58A)	ETR T-3C	10 Jun 1912	0.5	1433.3	35 620	35 860	$> 10^6$	–

[a] See footnote *a* to table 4.1.

Table 4.4. Possible US ocean-surveillance satellites

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
		1971						
USAF/USN (1971-110A)	WTR Thorad/A-D	14 Dec 1214	70.02	104.93	983	999	700	Navy ocean-surveillance satellites; quadruple launch
USAF/USAr (1971-110C)	WTR Thorad/A-D	14 Dec 1214	70.01	104.93	983	999	700	
USAF/USN (1971-110D)	WTR Thorad/A-D	14 Dec 1214	70.01	104.90	982	997	700	
USAF/USN (1971-110E)	WTR Thorad/A-D	14 Dec 1214	70.01	104.89	981	997	700	
		1975						
NASA/ GEOS C (1975-27A)	WTR Delta	10 Apr 0000	114.96	101.82	839	853	200	Geodynamic Experimental Ocean Satellite; the satellite was used to calibrate and to determine positions of NASA and other agency C-band radars, and to perform a satellite-to-satellite tracking experiment with ATS-6 spacecraft using an S-band transponder system

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
		1976						
USN/NOSS-1 (1976-38A)	WTR Atlas	30 Apr 1912	63.40	107.47	1 092	1 128	1 600	Navy ocean-surveillance satellites; quadruple launch
USN/SSU-1 (1976-38C)	WTR Atlas	30 Apr 1912	63.44	107.49	1 093	1 129	1 600	
USN/SSU-2 (1976-38D)	WTR Atlas	30 Apr 1912	63.43	107.50	1 093	1 130	1 600	
USN/SSU-3 (1976-38J)	WTR Atlas	30 Apr 1912	63.45	107.49	1 083	1 139	1 600	
		1977						
USN/NOSS-2 (1977-112A)	WTR Atlas F	8 Dec 1746	63.4	107.5	1 054	1 169	1 600	Navy ocean-surveillance satellites; quadruple launch
USA/NOSS-2 (1977/112C)	WTR Atlas F	8 Dec 1746	63.4	107.5	1 054	1 169	1 600	
USN/NOSS-2 (1977-112D)	WTR Atlas F	8 Dec 1746	63.4	107.5	1 054	1 169	1 600	
USN/NOSS-2 (1977-112E)	WTR Atlas F	8 Dec 1746	63.4	107.5	1 055	1 168	1 600	
		1978						
NASA/ Seasat A	WTR	27 Jun	108.02	100.63	776	800	200	

[a] See footnote *a* to table 4.1.

Table 4.5. US navigation satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
USAF/NDS 1 (1978-20A)	ETR Atlas F	20 Feb 2346	63.27	718.67	20 095	20 309	10^6	Navigation Development Satellites; first four of a six NavStar Global Positioning System (GPS); GPS is planned to consist of 24 satellites in 12-h circular orbits; the satellites will transmit the positioning signals and provide continuous global coverage; the main control station in the USA will monitor and update the satellite navigation subsystems and be able to determine the navigator's position to within 10 m accuracy in three dimensions, and the velocity to within a few cm/s; the GPS is designed to replace the present Transit navigation satellite system
USAF/NDS 2 (1978-47A)	WTR Atlas F	13 May 1033	63.13	711.30	19 952	20 084	10^6	
USAF/NDS 3 (1978-93A)	WTR Atlas F	7 Oct 0029	62.81	722.61	20 285	20 312	10^6	
USAF/NDS 4 (1978-112A)	WTR Atlas F	11 Dec 0419	63.27	722.38	20 267	20 316	10^6	

[a] See footnote *a* to table 4.1.

Table 4.6. US communications satellites launched during 1978[b]

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
USN/NASA Fleetsatcom 1 (1978-16A)	ETR Atlas/ Centaur	9 Feb 2122	2.77	1426.1	35 522	35 666	$> 10^6$	Provides communications for shipborne, airborne and ground tactical users, and relays ocean surveillance data
USAF/ DSCS II	ETR T-3C	25 Mar	–	–	–	–	–	Two satellites failed to orbit; malfunction in T-3C booster rocket; the launcher exploded from ground eight minutes after launching
USAF/SDS 3 (1978-21A)	ETR T-3B/A-D	25 Feb ~0448	63.15	703.7	311	39 377	..	Satellite Data System; approximate orbit
USAF/SDS 4 (1978-75A)	ETR T-3B/A-D	5 Aug 0448	63.3	703.8	380	39 315	10	Orbit and launch time unconfirmed
USAF/ DSCS 9 (1978-113A)	ETR T-3C	14 Dec 0043	2.49	1452.2	35 796	36 412	$> 10^6$	Defense Satellite Communications System; one of two DSCS will be placed over the Eastern Pacific and the other over the Western Pacific; orbit of DSCS 10 is unconfirmed
USAF/ DSCS 10 (1978-113B)	ETR T-3C	14 Dec 0043	2.50	1464.3	36 261	36 413	$> 10^6$	

[a] See footnote *a* to table 4.1.
[b] Only those satellites which are launched, operated or financed to a major extent by the military are included here.

Table 4.7. US weather satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
USAF/AMS3 (1978-42A)	WTR Th/Bu II	1 May 0307	98.71	101.47	820	835	80	Advanced Meteorological Satellite
NASA/ NOAA GOES 3 (1978-62A)	ETR Delta	16 Jun 1102	1.78	1446.85	35 473	36 521	$> 10^6$	Satellite, operated by the US National Oceanographic and Atmospheric Administration, is placed at about 135°W; this type of satellite is also used for obtaining ocean data; it replaces GOES 1 (1975-100A) which was placed at 60°E
NASA/ NOAA Tiros II (1978-96A)	WTR Atlas F	13 Oct 1117	98.91	102.12	850	866	500	Monitors ocean currents and upwellings; designed to operate for two years
NASA/ Nimbus 7 (1978-98A)	ETR Delta	24 Oct 0810	99.29	104.08	943	953	1 000	Nimbus second stage carried CAMEO–Chemically Active Materials Ejected from Orbit (Barium released on 29 Oct 1978)

[a] See footnote *a* to table 4.1.

Table 4.8. Soviet photographic reconnaissance satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (days)	Recovery beacon[b]	Comments
Cosmos 974 (1978-01A)	PL A-2	6 Jan 1550	62.81	89.61	178	334	12.6	TF	High resolution, manœuvrable satellite
Cosmos 984 (1978-06A)	PL A-2	13 Jan 1522	62.81	89.45	206	291	12.7	..	Low resolution, PDM
Cosmos 986 (1978-10A)	TT A-2	24 Jan 0950	65.01	89.39	172	318	13.8	TF	High resolution, manœuvrable satellite
Cosmos 987 (1978-13A)	PL A-2	31 Jan 1453	62.80	89.44	175	321	13.6	TF	High resolution, manœuvrable satellite

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (days)	Recovery beacon[b]	Comments
Cosmos 988 (1978-15A)	PL A-2	8 Feb 1214	72.84	89.87	201	335	11.8	TF	Low resolution, special subset
Cosmos 989 (1978-17A)	TT A-2	14 Feb 0936	65.05	89.36	169	318	13.8	..	High resolution
Cosmos 992 (1978-25A)	TT A-2	4 Mar 0735	71.34	89.79	203	323	12.9	..	Low resolution, PDM
Cosmos 993 (1978-27A)	PL A-2	10 Mar 1048	72.86	89.63	171	340	12.7	..	High resolution, manœuvrable satellite
Cosmos 995 (1978-30A)	PL A-2	17 Mar 1048	81.34	89.05	217	235	12.8	..	Low resolution, PDM
Cosmos 999 (1978-33A)	TT A-2	30 Mar 0755	71.39	89.79	174	352	12.9	TF	High resolution, manœuvrable satellite
Cosmos 1002 (1978-37A)	TT A-2	6 Apr 0922	65.05	89.37	205	283	12.84	TG	Low resolution
Cosmos 1003 (1978-40A)	PL A-2	20 Apr 1536	62.8	89.54	178	328	13.6	TF	High resolution, manœuvrable satellite
Cosmos 1004 (1978-43A)	PL A-2	5 May 1526	62.81	89.43	205	290	12.6	TG	Low resolution, PDM; scientific pickaback; the last of the first generation extended-duration satellites; the satellites transmitted PDM signals on 19.994 MHz[c]
Cosmos 1007 (1978-48A)	PL A-2	16 May 1048	72.83	89.69	168	350	12.7	TF	High resolution, manœuvrable satellite
Cosmos 1010 (1978-52A)	PL A-2	23 May 0726	81.38	89.00	215	229	12.9	..	Probably also performed Earth resources mission; low resolution; satellite launched to aid shipping
Cosmos 1012 (1978-54A)	PL A-2	25 May 1438	62.80	89.15	202	265	12.6	TG	First of the new third generation non-manœuvrable low-resolution satellites; they transmit two-tone short-wave beacon signals without telemetry on 19.994 MHz (19.989 MHz for high-resolution types)[c]

Cosmos 1021 (1978-57A)	PL A-2	10 Jun 0838	65.03	89.35	173	313	12.85	TF	Manœuvrable; high resolution
Cosmos 1022 (1978-59A)	PL A-2	12 Jun 1033	72.84	89.67	171	344	12.76	..	Manœuvrable; high resolution
Cosmos 1026 (1978-69A)	TT A-2	2 Jul 0936	51.78	88.99	207	248	4.0	..	Low resolution, third generation
Cosmos 1028 (1978-76A)	PL A-2	5 Aug 1453	67.14	88.66	170	247	29.5	..	Manœuvrable fourth generation long-lived satellite, high resolution; a capsule returned
Cosmos 1029 (1978-82A)	PL A-2	29 Aug 1507	62.81	89.57	179	330	9.68	..	High resolution; a 20 kg 0.6 m piece of the spacecraft's engine landed near Garnat-sur-Engièvre (Allier), France
Cosmos 1031 (1978-85A)	PL A-2	9 Sep 1507	62.82	89.59	182	329	12.6	TF	High resolution, manœuvrable satellite
Cosmos 1032 (1978-88A)	PL A-2	19 Sep 0810	81.34	88.93	215	215	12.83	TG	Low resolution, third generation; ice survey satellite
Cosmos 1033 (1978-89A)	PL A-2	3 Oct 1102	81.37	88.95	212	231	12.84	TK	Low resolution; second ice survey satellite in two weeks; Earth resources observations also
Cosmos 1042 (1978-92A)	PL A-2	8 Oct 1536	62.80	89.26	179	299	12.64	TF	High resolution, manœuvrable satellite
Cosmos 1044 (1978-97A)	PL A-2	17 Oct 1507	62.82	89.46	203	295	12.65	TG	Low resolution; third generation satellite
Cosmos 1046 (1978-102A)	PL A-2	1 Nov 1200	72.86	89.77	202	324	11.78	TL	Low resolution, special subset
Cosmos 1047 (1978-104A)	PL A-2	15 Nov 1146	72.86	89.77	171	354	12.77	TF	High resolution, manœuvrable satellite
Cosmos 1049 (1978-107A)	PL A-2	21 Nov 1200	72.86	89.59	169	338	12.76	TF	High resolution; long delay in locating return capsule
Cosmos 1050 (1978-108A)	PL A-2	28 Nov 1619	62.80	89.81	254	278	13.62	TF	High resolution, manœuvrable satellite
Cosmos 1059 (1978-110A)	PL A-2	7 Dec 1536	62.81	89.67	180	338	12.63	TF	High resolution, manœuvrable satellite
Cosmos 1060 (1978-111A)	TT A-2	8 Dec 0936	65.03	89.47	206	292	12.8	..	Low resolution, third generation

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (days)	Recovery beacon[b]	Comments
Cosmos 1061 (1978-114A)	PL A-2	14 Dec 1522	62.82	89.62	203	310	12.63	TG	Low resolution, third generation
Cosmos 1068 (1978-123A)	PL A-2	26 Dec 1536	62.80	90.17	177	391	12.6	..	High resolution, manœuvrable satellite
Cosmos 1069 (1978-124A)	PL A-2	28 Dec 1634	62.82	89.75	241	285	12.64	TL	Special subset, low resolution

[a] See footnote *a* to table 4.1.
[b] Recovery beacon data supplied by the Kettering Group.
[c] See Perry, G. E., 'New Soviet sky spies', *Flight International*, Vol. 115, No. 3644, 20 January 1979, p. 179.

Table 4.9. Possible Soviet electronic reconnaissance satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)
Cosmos 1008 (1978-49A)	PL C-1	17 May 1438	74.04	95.12	499	594	10
Cosmos 1062 (1978-115A)	PL C-1	15 Dec 1326	74.04	95.18	504	550	9

[a] See footnote *a* to table 4.1.

Table 4.10. Possible Soviet early-warning satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)
Cosmos 1024 (1978-66A)	PL A-2-e	28 Jun 0307	62.83	724.73	605	40 094	12
Cosmos 1030 (1978-83A)	PL A-2-e	6 Sep 0307	62.80	725.64	613	40 129	12

[a] See footnote *a* to table 4.1.

Table 4.11. Possible Soviet navigation satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments[b]
Cosmos 985 (1978-07A)	PL C-1	17 Jan 0322	82.94	104.79	945	1 022	1 200	Number 4 replaced Cosmos 894 which was number 8
Cosmos 991 (1978-22A)	PL C-1	28 Feb 0643	82.98	104.84	963	1 009	1 200	Number 5 replaced Cosmos 887 (number 7)
Cosmos 994 (1978-28A)	PL C-1	15 Mar 1550	82.93	105.05	980	1 011	1 200	
Cosmos 996 (1978-31A)	PL C-1	28 Mar 0126	82.93	104.80	957	1 010	1 200	Number 7 replaced Cosmos 804 (number 6)
Cosmos 1000 (1978-34A)	PL C-1	31 Mar 1355	82.93	104.90	965	1 012	1 200	The first satellite to be described officially by the USSR as part of a global navigation system; number 13
Cosmos 1011 (1978-53A)	PL C-1	28 May 1648	82.91	104.90	960	1 014	1 200	Number 6 replaced Cosmos 928 (number 1)
Cosmos 1027 (1978-74A)	PL C-1	27 Jul 0448	82.94	104.82	166	1 004	1 200	
Cosmos 1064 (1978-119A)	PL C-1	19 Dec 1229	82.95	98.69	424	965	8	Number 1 to replace Cosmos 991 (number 5); failed to circularize orbit; subsequently augmented by Cosmos 1072 (number 8)

[a] See footnote *a* to table 4.1.

[b] Numbers are the Soviet identity numbers for each satellite (see source below). These numbers allow positive identification of the satellite without the need to use predictions or orbital calculations.

Source: Perry, G. E., 'Soviet navigation satellites', *The Royal Air Force Quarterly*, Autumn 1978, pp. 276–84.

Table 4.12. Possible Soviet communications satellites launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
Cosmos 976 (1978-05A)	PL C-1	10 Jan 2053	74.03	115.14	1 457	1 465	9 000	
Cosmos 977 (1978-05B)	PL C-1	10 Jan 2053	74.03	114.54	1 403	1 465	7 000	
Cosmos 978 (1978-05C)	PL C-1	10 Jan 2053	74.03	114.74	1 421	1 465	8 000	
Cosmos 979 (1978-05D)	PL C-1	10 Jan 2053	74.03	114.95	1 440	1 465	9 000	
Cosmos 980 (1978-05E)	PL C-1	10 Jan 2053	74.03	115.36	1 465	1 478	10 000	Octuple launch
Cosmos 981 (1978-05F)	PL C-1	10 Jan 2053	74.03	115.59	1 465	1 478	10 000	
Cosmos 982 (1978-05G)	PL C-1	10 Jan 2053	74.03	115.81	1 465	1 518	10 000	
Cosmos 983 (1978-05H)	PL C-1	10 Jan 2053	74.03	116.05	1 465	1 540	10 000	
Molniya 3-9 (1975-09A)	PL A-2-e	24 Jan 0658	62.81	736.26	646	40 618	12	Replaced Molniya 3-3
Cosmos 990 (1978-19A)	PL C-1	17 Feb 1634	74.05	100.80	783	809	120	Store-dump communications satellite
Molniya 1-39 (1978-24A)	PL A-2-e	2 Mar 2248	62.82	738.14	617	40 739	12	Replaced Molniya 1-30
Molniya 1-40 (1978-55A)	PL A-2	2 Jun 1214	62.85	736.26	422	40 842	12	Replaced Molniya 1-34
Cosmos 1013 (1978-56A)	PL C-1	7 Jun 2150	74.02	116.40	1 480	1 557	10 000	
Cosmos 1014 (1978-56B)	PL C-1	7 Jun 2150	74.02	116.15	1 480	1 534	10 000	Octuple launch

Cosmos 1015 (1978-56C)	PL C-1	7 Jun 2150	74.02	115.93	1 475	1 519	10 000	
Cosmos 1016 (1978-56D)	PL C-1	7 Jun 2150	74.02	115.70	1 473	1 501	10 000	
Cosmos 1017 (1978-56E)	PL C-1	7 Jun 2150	74.02	115.49	1 460	1 495	9 000	
Cosmos 1018 (1978-56F)	PL C-1	7 Jun 2150	74.02	115.27	1 444	1 491	9 000	Octuple launch
Cosmos 1019 (1978-56G)	PL C-1	7 Jun 2150	74.02	115.06	1 425	1 491	8 000	
Cosmos 1020 (1978-56H)	PL C-1	7 Jun 2150	74.02	114.85	1 410	1 487	8 000	
Cosmos 1023 (1978-63A)	PL C-1	21 Jun 0936	74.08	100.76	783	805	120	Store-dump communications satellite
Molniya 1-41 (1978-72A)	PL A-2-e	14 Jul 1507	62.83	736.44	607	40 666	12	Replaced Molniya 1-35
Raduga 4 (1978-73A)	TT D-1-E	18 Jul 2248	0.5	1 477.84	36 473	36 730	$> 10^6$	Replaced Raduga 3 in Statsionar 2 position
Molniya 1-42 (1978-80A)	PL A-2-e	22 Aug 2346	62.87	735.68	443	40 793	12	Replaced Molniya 1-33
Cosmos 1034 (1978-91A)	PL C-1	4 Oct 0350	74.03	114.97	1 423	1 484	8 000	
Cosmos 1035 (1978-91B)	PL C-1	4 Oct 0350	74.03	114.74	1 405	1 482	7 000	
Cosmos 1036 (1978-91C)	PL C-1	4 Oct 0350	74.04	115.19	1 443	1 484	9 000	
Cosmos 1037 (1978-91D)	PL C-1	4 Oct 0350	74.03	115.41	1 463	1 484	9 000	Octuple launch
Cosmos 1038 (1978-91E)	PL C-1	4 Oct 0350	74.03	115.64	1 480	1 488	10 000	
Cosmos 1039 (1978-91F)	PL C-1	4 Oct 0350	74.03	116.38	1 481	1 554	10 000	
Cosmos 1040 (1978-91G)	PL C-1	4 Oct 0350	74.03	116.11	1 481	1 529	10 000	

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
Cosmos 1041 (1978-91H)	PL C-1	4 Oct 0350	74.03	115.88	1 480	1 510	10 000	Octuple launch
Molniya 3-10 (1978-95A)	PL A-2-e	13 Oct 0517	62.79	736.21	452	40 829	12	Probably a replacement for Molniya 3-6 (1976-127A)
Cosmos 1048 (1978-105A)	PL C-1	16 Nov 2150	74.03	100.89	785	816	120	Store-dump communications satellite
Cosmos 1051 (1978-109A)	PL C-1	5 Dec 1814	74.02	114.72	1 397	1 487	7 000	
Cosmos 1052 (1978-109B)	PL C-1	5 Dec 1814	74.02	114.92	1 412	1 490	8 000	
Cosmos 1053 (1978-109C)	PL C-1	5 Dec 1814	74.02	115.12	1 433	1 488	9 000	
Cosmos 1054 (1978-109D)	PL C-1	5 Dec 1814	74.02	115.33	1 449	1 491	9 000	
Cosmos 1055 (1978-109E)	PL C-1	5 Dec 1814	74.02	115.50	1 460	1 500	10 000	Octuple launch
Cosmos 1056 (1978-109F)	PL C-1	5 Dec 1814	74.02	115.77	1 472	1 508	10 000	
Cosmos 1057 (1978-109G)	PL C-1	5 Dec 1814	74.02	115.99	1 482	1 518	9 000	
Cosmos 1058 (1978-109H)	PL C-1	5 Dec 1814	74.02	116.24	1 481	1 541	10 000	

[a] See footnote *a* to table 4.1.

Table 4.13. Possible Soviet geodetic satellite launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)
Cosmos 1067 (1978-122A)	PL C-1	26 Dec 1326	82.97	109.07	1 158	1 208	3 000

[a] See footnote *a* to table 4.1.

Table 4.14. Possible Soviet inspector/destructor satellite launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime	Comments
Cosmos 1009 (1978-50A)	TT F-1-m	19 May 0014	65.86	108.64	966	1 364	0.17 day	Inspector/destructor satellite passed close to Cosmos 967 (1977-116A) target satellite launched on 13 December 1977; test made just before the Helsinki meeting between the USA and USSR to ban the ASAT system

[a] See footnote *a* to table 4.1.

Table 4.15. Possible photographic reconnaissance satellite launched in 1978 by the People's Republic of China

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (days)	Whether capsule recovered
China 8 (1978-11A)	Shuang-Cheng Tzu ..	25 Jan 0502	57.03	90.90	161	479	12	Yes

[a] See footnote *a* to table 4.1.

Table 4.16. European ocean-surveillance satellites

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)	Comments
		1977						
ESA/GEOS (1977-29A)	ETR Delta	20 Apr	26.5	718.5	2 076	38 315	10^5	European Space Agency's Geodynamics Experimental Ocean Satellites
		1978						
ESA/GEOS 2 (1978-71A)	ETR Delta	14 Jul 1048	0.80	1 421.17	35 777	35 614	$> 10^6$	Satellite will be placed between longitude 9° and 35°E

[a] See footnote *a* to table 4.1.

Table 4.17. NATO communications satellite launched during 1978

Satellite name and designation[a]	Launch site and vehicle	Launch date and time (GMT)	Orbital inclination (deg)	Period (min)	Perigee height (km)	Apogee height (km)	Lifetime (years)
NATO 3C (1978-106A)	ETR Delta	16 Nov 0058	4.41	1 428.6	35 516	35 768	$> 10^6$

[a] See footnote *a* to table 4.1.

Table 4.18. Summary of some characteristics of lasers suitable for weapon applications

Type of laser	Laser source	Wavelength of emitted radiation (μm)	Efficiency (%)	Possible power output kW/kg fuel per second	Comments
Chemical	Deuterium fluoride	3.7–4.1	~5	100–150	Deuterium fluoride operates in continuous wave mode while hydrogen fluoride operates either in this mode or pulsed mode; operates at low pressure (less than 0.01 atmosphere); suitable for space applications
	Hydrogen fluoride	2.5–3.0	~5		
EDL	Carbon monoxide	4.8–6.2	>50	45	Can operate in either mode; operates near atmospheric pressures; requires high voltage, thus making it heavy
	Carbon dioxide	10.6	25		
GDL	Carbon dioxide	10.6	..	~20	Operates at low pressures; it operates in continuous wave mode

Table 4.19. Minimum energy required to cause damage to some common materials[a]

Type of damage	Type of materials	Energy needed (kJ/cm^3)
Melting	Aluminium	2.5
	Tungsten	12.5
Vaporization	Metals	30–80
Vaporization or decomposition or depolymerization	Quartz, wood, acrylic plastics etc.	2–4

[a] Values refer to static conditions with calorimetric absorption.

Source: Spalding, I. J., 'Lasers—their applications and operational requirements', Lecture given at the Von Karman Institute Course on High Power Gas Lasers, Brussels, 11–15 March 1974.

Table 4.20. Department of Defense high-energy laser funding

	Programme number	Fiscal year ($ millions)					
		1975	1976	1977	1978	1979	1980
Army	63314 A	24.8	26.0	21.0	13.9	17.7	19.4
Navy	63754 N	38.6	50.6	44.1	15.3	33.7	55.5
Air Force	63605 F	56.2	54.4	79.9	76.3	94.3	107.0
DARPA	62301 E and 62711 E	21.1	20.9	21.5	25.7	33.2	41.6
Total		**140.7**	**151.9**	**166.5**	**131.2**	**178.9**	**223.5**

Sources: Hearings before the Committee on Armed Services, US Senate, 95th Congress (US Government Printing Office, Washington, D.C., 1977) Part 9, p. 6175; and Department of Defense, *Fiscal Year 1979 Research and Development Programs Guide* (The Information Group, Washington, D.C., 1978) Parts 1 and 2.

Table 4.21. Some useful power sources for laser weapons

Type of power source	Amount of power generated	Size and mass	Possible applications
Fuel cell	4 MW/30 second	~1 m^3 1 135 kg	Ground, ship-borne or air-borne
Rechargeable silver–zinc battery	4 MW/30 second	0.54 m^3 1 360 kg + 454 kg for transformer and AC/DC converter to increase the low battery voltage	Ground, ship-borne or possibly air-borne
Superconducting jet engine driver alternator	10 MW for 10 s pulses, with one pulse per minute	– 426 kg package	Ground, ship-borne or air-borne
Magneto-hydrodynamic generator	10 MW continuously until fuel is used up	– ~2 000 kg package	Mainly land-based or ship-borne
Nuclear reactor	1 000 MW to 2 000 MW continuously	– –	Ground only but energy could be transmitted via microwave link: 10–100 kW(e) smaller reactors have been developed for space

Source: Nahin, P. J., 'The laser BMD and other radiant energy weapons: some thoughts', *IEEE Transaction on Aerospace and Electronic Systems*, Vol. AES-13, No. 2, March 1977, pp. 96–107.

Table 4.22. Department of Defense funding for the PBW[a]

	Fiscal year ($ millions)			
Services	1977	1978	1979 (requests)	1980 (requests)
Army	4.4	3.8	4.3	4.5
Navy	5.3	7.0	5.6	5.6
Air Force	1.1	1.3	1.3	1.3
Total	**10.8**	**12.1**	**11.2**	**11.4**

[a] The amounts approved for DARPA efforts towards the development of detection, identification, tracking and weapon aiming must be added to these figures. In financial years 1978 and 1979, these amount to $31.7 millions and $27.7 millions respectively, and $42.7 millions have been requested for 1980. It should be remembered that the problems under investigation are common to both laser weapons and PBWs. Considerable efforts for the solution of these problems are also being made by the three armed services. The amounts approved for these developments are not shown above.

Sources: 'Directed energy programs', *Fiscal Year 1979 Arms Control Impact Statements* (US Government Printing Office, Washington, D.C., 1978), pp. 229–33; and Robinson, C. A., Jr., 'Air Force emphasizes laser weapons', *Aviation Week and Space Technology*, Vol. 109, No. 18, 30 October 1978, pp. 51–55.

Table 4.23. Some US and Soviet high-current pulsed electron accelerators

	Accelerator designation	Laboratory	Maximum energy (MeV)	Maximum current (KA)	Pulse length (nanoseconds)
USA	GAMBLE-II	Naval Research Laboratory	. .	. .	. .
	CASINO	Naval Surface Weapons Laboratory	. .	. .	. .
	HERMES-II	Naval Research Laboratory	. .	. .	. .
	REBA	Sandia Laboratory	. .	. .	. .
	AURORA	Harry Diamond Laboratory	12	1600	160
	PROTO-I	Sandia Laboratory	. .	. .	. .
	Advanced Test Accelerator (ATA)	Lawrence Livermore Laboratory	5	10	. .
USSR	IMPUL'S	Lebedev Physics Institute	1	30	50
	ESU-1	Lebedev Physics Institute	2	5	35
	NEPTUN	Kurchatov Institute of Atomic Energy	1	30	40
	TONUS	Tomsk Polytechnic Institute	2	60	50
	TEREK-2	Institute of Atmospheric Optics	0.55	10	30
	RIUS-1	Institute of Nuclear Physics	1	10	100
	RIUS-5	Institute of Nuclear Physics	4	30	40
	–	Lebedev Physics Institute	0.6	20	20

Table 4.24. Some US and Soviet heavy-ion accelerators

	Accelerator type	Location	Energy[a]
USA	Isochronous cyclotron; 88-inch	Berkeley	140 $(q/A)^2$ MeV/amu
	Super HILAC, Bevalac; tandem-drift linear accelerator and synchrotron	Berkeley	Drift linac: 8.5 MeV/amu Synchrotron: 2.6 GeV/amu for ion of $q/A = 0.5$
	MUSIC isochronous cyclotron	University of Maryland	180 $(q/A)^2$ MeV/amu
	Tandem isochronous accelerators	Michigan State University	$(50+500)\,(q/A)^2$ MeV/amu
	Isochronous cyclotron accelerators	Holifield Heavy Ion Research Facility, Oak Ridge	90 $(q/A)^2$ MeV/amu
	Isochronous cyclotron	University of Rochester	Cyclotron: 500 $(q/A)^2$ MeV/amu
	Isochronous cyclotron	Texas A and M University	147 $(q/A)^2$ MeV/amu
USSR	Isochronous cyclotron in tandem	Joint Institute for Nuclear Research, Dubna	Maximum energy in each accelerator = 156 $(q/A)^2$ MeV/amu and 250 $(q/A)^2$ MeV/amu
	Drift linear accelerator and synchrotron in tandem	Joint Institute for Nuclear Research Dubna	Drift linac: 4 MeV/amu; Synchrotron: 4.6 GeV/amu for ion of $q/A = 0.5$
	Isochronous cyclotron	Joint Institute for Nuclear Research, Dubna	725 $(q/A)^2$ MeV/amu
	Isochronous cyclotron	Kazakhstan	50 $(q/A)^2$ MeV/amu
	Isochronous cyclotron	Kiev	140 $(q/A)^2$ MeV/amu
	Isochronous cyclotron	Kurchatov Institute, Moscow	60 $(q/A)^2$ MeV/amu

[a] amu = atomic mass unit; q = charge; A = mass unit; MeV = mega-electronvolt.

Source: Grunder, H. A. and Selph, F. B., 'Heavy-ion accelerators', *Annual Review of Nuclear Science*, Vol. 27, 1977, pp. 388–89.

Table 4.25. Power requirement for various sensors and equipment aboard ocean-surveillance satellites

Sensor or equipment	Power (watts)
Microwave scatterometer	30
IR radiometer	7
Microwave radiometer	20
Synthetic aperture radar	3 400
TV sensor	150
Multispectral camera	160
Recording equipment on board	115
UHF communications link	5.4
S-band communications link	1.2
Total	**3 888.6**

Source: 'The potential of observation of the oceans from space', A report prepared for the National Council on Marine Resources and Engineering Development Executive, December 1967.

Table 4.26. Nuclear power generators on satellites and space probes

Satellite	Date of launch	SNAP no.	Power (W(e))	Comments
USN Transit-4A (1961-01)	29 Jun 1961	SNAP-3	2.7	Test for developing integrated navigation system; first nuclear power supply; Pu-238 fuel
USN Transit-4B (1961-AH1)	15 Nov 1961	SNAP-3	2.7	Similar to Transit-4A, SNAP-3, lifetime 8 months
USAF/USN (1963-38B)	28 Sep 1963	SNAP-9	..	Navigation satellite
USAF/USN (1963-49B)	5 Dec 1963	SNAP-9	..	Navigation satellite
USN Navigation satellite	21 Apr 1964	SNAP-9	25	Satellite failed to orbit; about 17 kCi of Pu-238 were distributed at about 50 km altitude; by 1970 about 95% of this was deposited on Earth's surface; 1 kg of Pu-238 fuel
USAF Snapshot (1965-27A)	3 Apr 1965	SNAP-10A	580	First nuclear reactor launched into space; fuel was 93% U-235; thermal power output 33.5 kW
Cosmos 80-84 (1965-70A-E)	3 Sep 1965	SNAP-1 type	..	Communications satellites; power source in one of the five satellites; probably used cerium-144 as fuel
Cosmos 86-90 (1965-73A-E)	18 Sep 1965	SNAP-1 type	..	Communications satellites; power source in one of the five satellites; probably used cerium-144 as fuel
NASA Nimbus 2 Weather satellite	18 May 1968	SNAP-19	25	Two power units were carried by the satellite but guidance malfunctioned and the satellite was exploded; power units recovered; Pu-238 fuel in each
NASA Nimbus 3 (1969-37A)	14 Apr 1969	SNAP-19	30	Two power units were carried by the satellite; Pu-238 fuel
NASA Apollo 11 Lunar Module (1969-59C)	16 Jul 1969	SNAP	15 W(th)	Early Apollo Scientific Experiment Package was kept warm during lunar night by two Pu-238 power sources
NASA Apollo 12 Lunar Module (1969-99C)	14 Nov 1969	SNAP-27	63.5	Apollo Lunar Surface Experiment Package
Apollo 13 Lunar module (1970-29C)	11 Apr 1970	SNAP-27	63.5	The power source from the Lunar module was jettisoned in the South Pacific Ocean; no contamination was found; 3.8 kg of the Pu-238 fuel (44.5 kCi)
Luna 17/ Lunokhod 1 (1970-95A)	10 Nov 1970	–	..	RTG power generator
NASA Apollo 14 Lunar module (1971-8C)	1 Feb 1971	SNAP-27	30	Third lunar module landed on 5 Feb 1971; strontium-90 used as a fuel
NASA Apollo 15 Lunar module (1971-63C)	26 Jul 1971	SNAP-27	..	Lunar module landed on the Moon on 30 July 1971
NASA Pioneer-10 (1972-12A)	3 Mar 1972	..	30	RTG, unmanned spacecraft flew by Jupiter in December 1973

Satellite	Date of launch	SNAP no.	Power (W(e))	Comments
NASA Apollo 16 Lunar module (1972-31C)	16 Apr 1972	SNAP-27	. .	–
USAF Triad-01-1X Transit navigation (1972-69A)	2 Sep 1972	. .	30	RTG power generator
NASA Apollo 17 Lunar module (1972-96C)	7 Dec 1972	SNAP-27	. .	–
Luna 21/ Lunokhod 2 (1973-1A)	8 Jan 1973	–	. .	RTG power generator
NASA Pioneer-11 (1973-19A)	6 Apr 1973	–	30	Spacecraft flew by Jupiter in December 1974 and will encounter Saturn in September 1979
NASA Viking-1 Lander (1975-75G)	20 Aug 1975	–	35	RTG; Lander landed on Mars on 20 July 1976
NASA Viking-2 Lander (1975-83C)	9 Sep 1975	–	35	Lander landed on Mars on 3 September 1976
USAF Les-8 (1976-23A)	15 Mar 1976	–	145	RTG power generator
USAF Les-9 (1976-23B)	15 Mar 1976	–	145	RTG power generator
Soviet Cosmos 954 (1977-90A)	18 Sep 1977	–	. .	Satellite entered Earth's atmosphere on 24 January 1978; it mainly burnt up but some pieces were recovered which were radioactive; 17 such ocean-surveillance satellites have been launched; most of these have carried nuclear power reactors on board fuelled with highly enriched uranium-235

References

1. *Outer-Space—Battlefield of the Future?* (Taylor & Francis, London, 1978, Stockholm International Peace Research Institute).
2. *World Armaments and Disarmament, SIPRI Yearbook 1978* (Taylor & Francis, London, 1978, Stockholm International Peace Research Institute), pp. 106–14.
3. 'US anti satellite systems', *Fiscal year 1979 Arms Control Impact Statements'* (US Government Printing Office, Washington, D.C., 1978), pp. 101–106.
4. Allen, J.L., Prepared Statement, Hearings before the Committee on Armed Services, US Senate, 95th Congress (US Government Printing Office, Washington D.C., 1977), Part 9, pp. 6159–67.
5. 'Air Force begins regular test-firing of a prototype anti-aircraft laser', *Laser Focus*, Vol. 8, No. 1, January 1972, pp. 12–13.
6. 'High energy laser programs', *Fiscal Year 1979 Arms Control Impact Statements* (US Government Printing Office, Washington D.C., 1978), pp. 224–225.
7. Klass, P. J., 'Special report: laser weapons—current systems still more cost-effective', *Aviation Week and Space Technology,* Vol. 103, No. 10, 8 September 1975, pp. 53–59.
8. *Aviation Week and Space Technology,* Vol. 105, No. 8, 28 August 1976, p. 9.
9. Scoville, H.J. and Tsipis, K., 'Çan space remain a peaceful environment?' *Occasional Paper 18* (The Stanley Foundation, Muscatine, July 1978), p. 17.
10. Klass, P.J., 'Laser destroys missile in test', *Aviation Week and Space Technology,* Vol. 109, No. 6, 7 August 1978, p. 14.
11. Robinson, C. A., Jr., 'Soviets push for beam weapons', *Aviation Week and Space Technology,* Vol. 106, No. 18, 2 May 1977, pp. 16–23.
12. 'Directed energy programs', *Fiscal Year 1979 Arms Control Impact Statements* (US Government Printing Office, Washington D.C., 1978), pp. 229–33.
13. Robinson, C. A., Jr., 'Air Force emphasizes laser weapons', *Aviation Week and Space Technology*, Vol. 109, No. 18, 30 October 1978, pp. 51–55.
14. Robinson, C. A. Jr., 'US pushes development of beam weapons', *Aviation Week and Space Technology*, Vol. 109, No. 4, 2 October 1978, pp. 14–22.
15. Garwin, R. L., 'Charged-particle beam weapons?' *Bulletin of the Atomic Scientists,* Vol. 23, No. 8, October 1978, pp. 24–27.
16. Bekeji, G., Feld, B. T., Parmentola, J. and Tsipis, K., 'Particle Beam Weapons', Report No. 4, *Program in Science and Technology for International Security* (Department of Physics, Massachusetts Institute of Technology, Cambridge, December 1978).
17. Robinson, C. A., Jr., 'Key beam weapon tests started', *Aviation Week*

and Space Technology, Vol. 109, No. 15, 9 October 1978, pp. 42–53.
18. Scoville, H., Jr., 'Problems of international security in Outer Space', *Eighteenth Strategy For Peace*, Conference Report, 13–16 October 1977 (Airlie House, Warrenton, 1978), pp. 23–39.
19. Stanley, M. C., *Eighteenth Strategy For Peace,* Conference Report, 13–16 October 1977 (Airlie House, Warrenton, 1978), pp. XII–XIII.
20. *Seventeenth Strategy For Peace*, Conference Report, 7–10 October 1976 (Airlie House, Warrenton, 1977), pp. 10–11.
21. Jasani B., 'Why we should ban the military use of satellites', *Nature*, Vol. 273, No. 5662, 8 June 1978, p. 416.
22. 'Seasat, an ocean dedicated satellite', *Sea Technology,* Vol. 19, No. 5, May 1978, p. 33.
23. Hardy, E. P., Krey, P. W. and Volchok, H. L., 'Global inventory and distribution of fallout plutonium', *Nature*, Vol. 214, No. 5390, 16 February 1973, pp. 444–45.
24. Klass, P. J., 'Russians believed deploying comsat net', *Aviation Week and Space Technology*, Vol. 83, No. 15, 11 October 1965, p. 29.
25. 'Cosmos re-entry spurs nuclear waste debate', *Aviation Week and Space Technology*, Vol. 108, No. 5, 30 January 1978, p. 33.
26. *The Potential of Observation of the Oceans from Space*, A report prepared for the National Council on Marine Resources and Engineering Development Executive, December 1967.
27. 'GEOS-C flight exceeds expectations of planners', *Aviation Week and Space Technology,* Vol. 102, No. 17, 28 April 1975, p. 97.
28. 'Expanded ocean surveillance effort set', *Aviation Week and Space Technology*, Vol. 109, No. 2, 10 July 1978, pp. 22–23.
29. 'US Navy plans surveillance network', *Flight International*, Vol. 113, No. 3630, 14 October 1978, p. 1427.
30. '"DoD" Major new satellite programs', *Armed Forces Journal International*, February 1978, p. 25.
31. Perry, G. E., 'Russian ocean surveillance satellites', *The Royal Air Force Quarterly*, Vol. 18, Spring 1978, pp. 60–67.
32. 'Soviets seen operating two types of ocean surveillance satellite', *Aerospace Daily*, Vol. 79, No. 22, 2 June 1976, pp. 169–70.

5. Nuclear power and nuclear proliferation: export policies and proliferation resistance

Square-bracketed numbers, thus [1], *refer to the list of references on page 328.*

I. The proliferation of weapon capabilities

At the present time, proliferation concerns the spread of capabilities to make nuclear weapons rather than of ready-made arsenals. It is the materials with which weapons can be made, the ability to use them and, sometimes, the rationale for acquiring nuclear weapons which are being proliferated. If the lead time between capability and operational weapons can be reduced to days, or even hours, then readiness could be achieved during the course of a conflict. Such speed of mobilization is comparable to that of the armies of most countries [1].

The Non-Proliferation Treaty (NPT) sets no limits as to how close a nation may come to weapon assembly. Furthermore, non-NPT countries not subject to full-scope safeguards can leave the world unclear as to whether they have crossed the threshold or not. Nuclear weapons can with reasonable certainty be assumed to work without prior testing. Indeed, the political costs of testing may outweigh the technical benefits. As Israel and South Africa have shown, there are other ways of drawing attention to the potential existence of nuclear weapons and more subtle ways of reaping the political advantages of advanced nuclear status.

II. The contraction of the international nuclear market

In the first half of the 1970s, the international nuclear market expanded rapidly in terms of the volume and value of transactions and the numbers of suppliers and buyers involved. The first fuel-cycle agreements were negotiated at this time. In the second half of the decade, however, the proliferation of nuclear materials, technology and equipment has slowed down significantly.

The plans for nuclear power have been considerably cut back. Earlier projections have been reduced in the face of a falling demand for energy, political opposition to nuclear power, new regulatory demands and complexities, and stricter export conditions. At the end of 1978, 215 power reactors in 22 countries produced 112 GW(e) (see table 5.1). The projections for 1981 and 1984 are 217 GW(e) and 339 GW(e)

Table 5.1. World nuclear power capacity in operation as of 1976, 31 November 1978 and projected for 1981 and 1984

Country	Total nuclear power capacity 1976 (MW(e) (net))	Number of power reactors 1976 (>20 MW(e))	Total nuclear power capacity 1978 (MW(e) (net))	Number of power reactors 1978 (>20 MW(e))	Total nuclear power capacity 1981 (MW(e) (net))	Number of power reactors 1981[c] (>20 MW(e))	Total nuclear power capacity 1984 (MW(e) (net))	Number of power reactors 1984[d] (>20 MW(e))
Argentina	319	1	345	1	945	2	945	2
Austria[a]	–	–	–	–	692	1	692	1
Belgium	1 663	3	1 676	3	3 475	5	5 487	7(2)
Brazil	–	–	–	–	626	1	1 871	2
Canada	2 535	7	4 755	10	7 275	14	10 323	19
Cuba	–	–	–	–	–	–	880	2(1)
Czechoslovakia	110	1	491	2	2 131	6(1)	3 391	9(4)
Finland	–	–	1 080	2	2 160	4	2 160	4
France	2 723	10	6 353	14	22 843	32	35 308	44(4)
FR Germany	4 855	3	8 174	12	14 327	18	24 107	27(3)
German DR	879	2	1 287	4	4 143	11(2)	4 959	13(4)
Hungary	–	–	–	–	408	1	1 224	3(1)
India	603	3	602	3	1 249	6	1 689	8
Iran	–	–	–	–	2 400	2	6 582	6(2)
Italy	542	3	1 382	4	1 382	4	5 278	9(2)
Japan	7 067	13	12 129	19	14 995	23	22 179	32(5)
Korea, South	–	–	564	1	1 798	3	2 698	4(1)
Mexico	–	–	–	–	–	–	1 308	2
Netherlands	499	2	499	2	499	2	499	2
Pakistan	126	1	126	1	126	1	126	1
Philippines	–	–	–	–	–	–	621	1
Poland	–	–	–	–	–	–	408	1
Romania	–	–	–	–	–	–	440	1(1)
South Africa	–	–	–	–	–	–	1 843	2
Spain	1 073	3	1 073	3	6 352	9	10 262	13(3)
Sweden	3 244	5	3 700	6	7 322	10	8 382	11
Switzerland	1 006	3	1 006	3	3 793	6	6 833	9(3)
Taiwan[b]	–	–	604	1	1 208	2	4 015	5(1)
Turkey	–	–	–	–	–	–	620	1(1)
UK	4 302	28	6 890	32	10 696	39	10 696	39
USA	39 590	57	49 989	69	84 663	101	129 155	142(2)
USSR	6 166	20	7 616	21	18 816	36	21 316	38
Yugoslavia	–	–	–	–	632	1	632	1

Totals	1976	1978	1981	1984
No. of countries having at least 1 reactor >20 MW(e)	**19**	**22**	**27**	**34**
No. of reactors >20 MW(e)	**173**	**215**	**344**(3)	**465**(40)
Capacity in MW(e) (including reactors) >20 MW(e)	**73 139**	**111 911**	**216 632**	**338 606**

[a] Following the referendum on 5 November 1978, the nuclear reactor at Zwentendorf will not be commissioned.

[b] Taiwan is not a member of the IAEA. The figures are taken from *Nuclear Engineering International*, Vol. 23, No. 274, July 1978 (supplement issue).

[c] The numbers in brackets indicate the number of reactors included in the total figure for reactors planned for 1981, but not reported to be under construction as of 31 December 1978. First year of commercial operation will therefore almost certainly be later than 1981.
[d] The numbers in brackets indicate the number of reactors included in the total figure for reactors planned for 1984, but not reported to be under construction as of 1 December 1978. First year of commercial operation will therefore almost certainly be later than 1981.

Sources: Power Reactors in Member States (Vienna, 1978, IAEA), updated with the assistance of the IAEA to 31 December 1978, *Nuclear Engineering International*, Vol. 23, January–December 1978.

respectively, but are still almost certain to be too high.[1] The number of Third World countries with firm nuclear power programmes—once expected to grow rapidly during this decade—has actually kept rather stable: 12 countries are now scheduled to have power reactors in operation by 1984.[2] There have been only two newcomers over the last 10–15 years: Cuba and Iran. Certainly more countries are indicating an interest in nuclear power. The signing of a French–Chinese agreement covering nuclear research and Framatome's negotiations with China for the delivery of two 900 MW(e) power reactors are most interesting developments. The pace, however, is much slower than previously assumed.

The nuclear power industry is facing both domestic and international market contraction. KWU (Kraftwerkunion AG) in FR Germany and ASEA-Atom in Sweden received no new domestic orders for reactors in 1978, for the third year in succession. In the USA, only two new orders were placed, both with Westinghouse. Table 5.2 gives an overview of the export market for the end of 1978. Over the last two years, only 11 new reactors entered the construction stage, with AEE (Atomenergoexport in the USSR) accounting for four (two in Bulgaria, one in Poland and one in Cuba), FRAM (Framatome in France) accounting for four (two in South Africa and two in Iran), GEC (General Electric Co. in the UK with GETSCO [General Electric Technical Services Co., in the USA] and AMN [Ansaldo Meccanico Nucleare in Italy]) accounting for two (in Italy), and Westinghouse (USA) for one (in the Philippines). No new companies are entering the reactor market at present and, so far, none has withdrawn.

The export of fuel-cycle components has also come to a temporary if not permanent halt. France balked at the agreement to build a reprocessing plant in Pakistan. Representations to that effect had been made both by the USA and the USSR. France offered to proceed with

[1] Some reactors scheduled to be in operation by these years are not yet under construction and are therefore unlikely to meet the schedule. Others are likely to be delayed for technical, regulatory and political reasons, and because contractors are stretching the construction time for lack of new orders.
[2] Argentina, Brazil, Cuba, India, Iran, South Korea, Mexico, Pakistan, Philippines, Taiwan and Yugoslavia (see table 5.1). Bulgaria and Romania are not classified as Third World countries. Turkey plans to have a reactor in operation by 1984, but has not signed any contract yet.

Table 5.2. International trade in power reactors: reactors in operation, under construction or planned for export, by supplying country and main contractor, as of 31 December 1978

Supplier/ recipient country	Contractor	Reactor type[s]	Net power output (MW(e))	Year of commercial operation
Canada			**Operating reactors**	
India	AECL[a]	PHWR	206	1973
Pakistan	CGE[b]	PHWR	126	1972
			Reactors under construction	
Argentina	AECL/CEPEC/CNEA[c]	PHWR	600	1980
India	AECL	PHWR	207	1979
Korea, South	AECL	PHWR	629	1981
			Planned reactors	
Argentina	AECL/AMN, NIRA[d] or KWU	PHWR	560	1986
Romania[g]	AECL	PHWR	600	1986
	AECL	PHWR	600	1987
France			**Operating reactors**	
Belgium	FRAM	PWR	880	1975
Spain	CEA[e]	GCR	480	1972
			Reactors under construction	
Belgium	FRAM/ACEC[f]	PWR	897	1980
Belgium	FRAM	PWR	902	1980
Iran	FRAM	PWR	891	1983
Iran	FRAM	PWR	891	1984
South Africa	FRAM	PWR	922	1982
South Africa	FRAM	PWR	922	1983
FR Germany			**Operating reactors**	
Argentina	KWU	PHWR	345	1974
Austria[h]	KWU	BWR	692	1978
Netherlands	KWU	PWR	447	1973
			Reactors under construction	
Brazil	KWU	PWR	1 245	1983
Brazil	KWU	PWR	1 245	1984
Iran	KWU	PWR	1 200	1980
Iran	KWU	PWR	1 200	1981
Spain	KWU	PWR	990	1985
Switzerland	KWU	PWR	920	1979
			Planned reactors	
Argentina	KWU or AECL/AMN, NIRA	PHWR	560	1986
Iran	KWU	PWR	1 200	1987
Spain	KWU	PWR	900	1986
Spain	KWU	PWR	1 000	1986
Spain	KWU	–	1 000	1986
Sweden			**Operating reactors**	
Finland	ASEA	BWR	660	1978
			Reactors under construction	
Finland	ASEA	BWR	660	1980
UK			**Operating reactors**	
Italy	TNPG[i]	GCR	150	1964
Japan	GEC	GCR	159	1966

Supplier/ recipient country	Contractor	Reactor type[s]	Net power output (MW(e))	Year of commercial operation
USA			**Operating reactors**	
Belgium	WEST[j]	PWR	11	1962
Belgium	WEN[k]/ACEC	PWR	393	1975
Belgium	WEN/ACEC	PWR	393	1975
Germany, FR	GE[l]	BWR	15	1962
Germany, FR	GE	BWR	237	1967
India	GE	BWR	198	1969
India	GE	BWR	198	1969
Italy	GE	BWR	150	1964
Italy	WEST	PWR	242	1965
Italy	GETSCO/AMN	BWR	840	1978
Japan	GE	BWR	10	1963
Japan	GE	BWR	340	1970
Japan	WEST/M[m]	PWR	320	1970
Japan	GE	BWR	439	1971
Japan	WEST/M	PWR	780	1974
Japan	GE	BWR	760	1974
Japan	WEST	PWR	1 120	1978
Japan	GE	BWR	1 056	1978
Korea, South	WEST	PWR	564	1978
Netherlands	GE	BWR	52	1969
Spain	WEST	PWR	153	1969
Spain	GE	BWR	440	1971
Sweden	WEST	PWR	800	1975
Switzerland	WEST	PWR	350	1969
Switzerland	GETSCO	BWR	306	1972
Switzerland	WEST	PWR	350	1971
Taiwan	GE	BWR	604	1978
UK	B&W[n]/EE[o]/TWC[p]	GCR	2×210	1966
UK	B&W/EE/TWC	GCR	420	1971
UK	B&W/EE/TWC	GCR	420	1972
			Reactors under construction	
Brazil	WEST	PWR	626	1979
Italy	GETSCO/AMN	BWR	980	1983
Italy	GETSCO/AMN	BWR	980	1984
Japan	GE	BWR	1 067	1979
Japan	WEST	PWR	1 120	1979
Korea, South	WEST	PWR	605	1981
Mexico	GE	BWR	654	1982
Mexico	GE	BWR	654	1983
Philippines	WEST	PWR	621	1982
Spain	WEST	PWR	833	1979
Spain	WEST	PWR	883	1980
Spain	WEST	PWR	900	1979
Spain	WEST	PWR	900	1979
Spain	WEST	PWR	882	1980
Spain	WEST	PWR	882	1981
Spain	GE	BWR	935	1982
Sweden	WEST	PWR	912	1979
Sweden	WEST	PWR	912	1980
Switzerland	GETSCO	BWR	942	1980
Switzerland	GETSCO	BWR	925	1981
Taiwan	GE	BWR	604	1980
Taiwan	GE	BWR	951	1981
Taiwan	GE	BWR	951	1982
Yugoslavia	WEST	PWR	632	1980

Supplier/ recipient country	Contractor	Reactor type[s]	Net power output (MW(e))	Year of commercial operation
			Planned reactors	
Belgium	WEN/ACEC	PWR	1 006	1983
Belgium	WEN/ACEC	PWR	1 006	1983
Italy	WEST/EI[q]	PWR	950	1984
Italy	WEST/EI	PWR	950	1984
Japan	GE/TOSHIBA[r]	BWR	1 067	1983
Korea, South	WEST	PWR	900	1984
Korea, South	WEST	PWR	900	1985
Spain	GE	BWR	939	1984
Spain	GE	BWR	939	1985
Spain	WEST	PWR	1 036	1984
Spain	GE	BWR	900	–
Spain	WEST	PWR	1 000	1983
Spain	WEST	PWR	1 000	1987
Switzerland	GETSCO	BWR	1 140	1982
Taiwan	WEST	PWR	907	1984
Taiwan	WEST	PWR	907	1985
USSR			**Operating reactors**	
Bulgaria	AEE	PWR	432	1974
Bulgaria	AEE	PWR	405	1975
Czechoslovakia	AEE	PWR	381	1978
Finland	AEE	PWR	420	1977
German DR	AEE	PWR	63	1966
German DR	AEE	PWR	408	1974
German DR	AEE	PWR	408	1974
German DR	AEE	PWR	408	1978
			Reactors under construction	
Bulgaria	AEE	PWR	420	1979
Bulgaria	AEE	PWR	420	1979
Czechoslovakia	AEE	PWR	381	1979
Czechoslovakia	AEE	PWR	420	1980
Czechoslovakia	AEE	PWR	420	1980
Cuba	AEE	PWR	440	1983
Finland	AEE	PWR	420	1979
German DR	AEE	PWR	408	1979
German DR	AEE	PWR	408	1979
German DR	AEE	PWR	408	1980
German DR	AEE	PWR	408	1980
German DR	AEE	PWR	408	1980
Hungary	AEE	PWR	408	1980
Hungary	AEE	PWR	408	1983
Poland	AEE	PWR	408	1983
			Planned reactors	
Czechoslovakia	AEE	PWR	420	1981
Czechoslovakia	AEE	PWR	420	1982
Czechoslovakia	AEE	PWR	420	1983
Czechoslovakia	AEE	PWR	420	1984
Czechoslovakia	AEE	PWR	420	1985
Czechoslovakia	AEE	PWR	420	1986
Czechoslovakia	AEE	PWR	420	1985
Cuba	AEE	PWR	440	1984
Finland	AEE	PWR	1 000	1986
German DR	AEE	PWR	408	1981
German DR	AEE	PWR	408	1981
German DR	AEE	PWR	408	1982

Supplier/ recipient country	Contractor	Reactor type[s]	Net power output (MW(e))	Year of commercial operation
German DR	AEE	PWR	408	1982
Hungary	AEE	PWR	408	1984
Hungary	AEE	PWR	408	1985
Poland	AEE	PWR	408	1985
Poland	AEE	PWR	1 000	–
Romania	AEE	PWR	440	1983

[a] AECL = Atomic Energy of Canada Ltd (Canada)
[b] CGE = Canadian General Electric (Canada)
[c] CNEA = Comision Nacional de Energie Atomica (Argentina)
[d] NIRA = Nucleare Italiana Reattori Avanzati (Italy)
[e] CEA = Commissariat à l'Energie Atomique (France)
[f] ACEC = Association de Constructions Electrique de Charleroi (Belgium)
[g] The licensing agreement between Canada and Romania permits the construction of two more CANDU reactors. In all, the Romanian nuclear power programme calls for the construction of 16 nuclear power stations over the next 20 years.
[h] Not commissioned. See footnote [a] to table 5.1.
[i] TNPG = The Nuclear Power Group Ltd (UK)
[j] WEST = Westinghouse Electric Corporation (USA)
[k] WEN = Westinghouse Nuclear Europe (USA)
[l] GE = General Electric (USA)
[m] M = Mitsubishi (Japan)
[n] B&W = Babcock and Wilcox Co. (USA)
[o] EE = English Electric (UK)
[p] TWC = Taylor Woodrow Construction (UK)
[q] EI = Ellectronucleare Italiana (Italy)
[r] TOSHIBA = Tokyo Shibaua Electric Co. (Japan)
[s] Reactor types:
BWR Boiling light water-moderated and -cooled
GCR Gas-cooled graphite-moderated
PWR Pressurized light water-moderated and -cooled
PHWR Pressurized heavy water-moderated and -cooled

Sources: See sources to table 5.1.

the sale of a co-processing plant[3] instead, but Pakistan declined any interest. At the end of 1978, all plans for the delivery of fuel-processing equipment to Pakistan seemed to be cancelled. The only remaining contract in this field is the pilot reprocessing plant to be built at Resende, Rio de Janeiro, as part of the German–Brazilian agreement. This plant is scheduled to start up in 1984.

The US Non-Proliferation Act makes cut-off of US nuclear exports mandatory if an agreement for the transfer of reprocessing technology or equipment is entered into, and discourages international commerce in enrichment facilities by threat of such cut-off,[4] except in connection

[3] Unlike conventional reprocessing facilities, a co-processing plant separates the fission products only, leaving the uranium and plutonium in a mixture unsuitable for weapons.
[4] The Act forbids nuclear exports to any nation or group of nations that is found by the President to have "assisted, encouraged or induced any non-nuclear-weapon state to engage in activities involving source or special nuclear material and having direct significance for the manufacture or acquisition of nuclear explosive devices, and has failed to take steps which, in the President's judgement, represent sufficient progress toward terminating such assistance, encouragement, or inducement" [2].

with the International Fuel Cycle Evaluation (INFCE) or pursuant to an international agreement or undertaking to which the USA subscribes. In the short term, the German and French unilateral moratoria on export of sensitive technology ensure that export policies are compatible across the Atlantic. In the long run, views may again diverge, depending on the choice of fuel cycles and subsequent interests in international nuclear commerce.

III. The extension of safeguards

By the end of 1978, 561 nuclear facilities and material deposits were under IAEA safeguards. One hundred and two power reactors and 174 research reactors were inspected, including fast reactors. Safeguards were applied at two commercial reprocessing plants (Tokai in Japan and WAK in FR Germany) and at three pilot plants (DUREX-1 and ITREC-Rotondella in Italy, and Juan Vigon in Spain) (see table 5.5). One commercial enrichment plant (Almelo in the Netherlands) and two pilot plants (Tokai in Japan and Almelo in the Netherlands) were thus safeguarded. Safeguards thus apply to all parts of the fuel cycle in its most advanced form. Pursuant to agreements concluded in 1978, IAEA safeguards will be applied to all declared activities in France and the UK, starting in the course of 1979.

The number of operating nuclear facilities not subject to IAEA or bilateral safeguards did not change during 1978. Twelve facilities in five countries remain unsafeguarded. In addition there are laboratory-scale activities such as the reprocessing facilities in Pakistan and Egypt (status uncertain), and some small-scale fuel fabrication capability in Pakistan (see table 5.3).

The guidelines adopted by the London Nuclear Suppliers Group [3–5] introduced the principle that safeguards shall be triggered by the transfer of technology, and not merely of hardware-technology being defined as technical data in physical form and designated by the supplying country to be important for the design, construction, operation, or maintenance of enrichment, reprocessing or heavy water facilities, or their major critical components. While 95 per cent of the plans for the reprocessing plant in Pakistan were reportedly transferred to Pakistan by Saint Gobain Techniques Nouvelles, this technology was not so designated as to trigger safeguards. So far, the IAEA has not been asked to safeguard any technology transfer of the kind spelt out in the London guidelines.

The list of items which, when exported, triggers the application of safeguards, in accordance with article III.2 of the NPT [6], includes heavy water. Nine safeguards transfer agreements and one unilateral agreement presently provide for the safeguarding of such material. Altogether, they cover about 750 tonnes of heavy water. The trigger list issued by the Nuclear Suppliers Group also included plants for the production of heavy water, deuterium and deuterium compounds, and equipment especially designed or prepared for them. While heavy water facilities are not covered by the NPT type of safeguards, the transfer of equipment or technology for heavy water production will therefore trigger international safeguards insofar as the suppliers participate in the Nuclear Suppliers Group or feel bound by its guidelines.

It was largely India's nuclear explosion which increased the focus of attention on the proliferation implications of heavy water. The Circus reactor in India, which produced plutonium for the device, used heavy water from the USA. Less well known is the Norwegian supply of heavy water for the same type of reactor at Dimona, Israel. The plutonium produced by the Dimona reactor is widely assumed to be extracted at the adjacent reprocessing plant, and used for military purposes. Both facilities are unsafeguarded.

Table 5.4 shows current and anticipated heavy water production capacities as of 31 December 1978. Canada is by far the largest producer of heavy water, and plans to expand its capacity. India aims at meeting its own needs, but faces considerable delays as a result of accidents (Baroda), strikes (Rajastan), and engineering difficulties (due to the almost simultaneous construction of four plants). In Norway, production has been reduced to 12 tonnes per year, and in the USA to about 1 tonne per year. The Soviet and Chinese capacities for heavy water production are unknown, as is that of Israel, where a small-scale facility is assumed to exist. Argentina is about to build a pilot facility, to be followed by a large-scale plant. The USA probably keeps a heavy water stock of some 100–200 tonnes, while the Soviet stock is assumed to be small after the sale of 55 tonnes to India in 1976. Furthermore, heavy water may be sold by other countries when heavy water reactors are closed down, as was the case when reactors at Karlsruhe, FR Germany, and Ågesta and Marviken, Sweden, went out of operation (sales were made to Japan and Canada respectively). None of the facilities listed in table 5.4 are subject to safeguards, and no transfer of heavy water technology or hardware has so far triggered IAEA safeguards.

IV. The implications of differential export conditions

The USA is renegotiating 25 bilateral and two multilateral agreements (with Euratom and the IAEA) for cooperation under the Nuclear Non-

Table 5.3. Operating nuclear facilities not subject to IAEA or bilateral safeguards, as of 31 December 1978[a]

Country	Facility	Indigenous or imported	First year of operation
Egypt	Inshas research reactor	Imported (USSR)	1961
India	Apsara research reactor	Indigenous	1956
	Cirus research reactor	Imported (Canada/USA)	1960
	Purnima research reactor	Indigenous	1972
	Fuel fabrication plant at Trombay	Indigenous	1960
	Fuel fabrication plant, CANDU type of fuel elements, at the Nuclear Fuel Cycle complex, Hyderabad	Indigenous	1974
	Reprocessing plant at Trombay	Indigenous	1964
	Reprocessing plant at Taraptur	Indigenous	1977
Israel	Dimona research reactor	Imported (France)	1963
	Reprocessing plant	Indigenous (in collaboration with France)[b]	. .
South Africa	Pilot enrichment plant	Indigenous (in collaboration with FR Germany)[b]	1975
Spain	Vandellos power reactor	Operation in co-operation with France	1972

[a] Significant nuclear activities outside the five nuclear weapon states recognized by the NPT. The list is based on the best information available to SIPRI. In addition there are laboratory-scale activities such as the reprocessing facilities in Pakistan (first year of operation: 1970) and Egypt (see table 5.5) and some small-scale fuel fabrication capability in the same country, established with the assistance of Belgo-Nucleare, Belgium. Furthermore, no safeguards agreement has yet been negotiated for the fuel fabrication plant under construction at Ezeiza, Argentina. The plant will manufacture natural uranium fuel elements using Argentinian uranium, and is scheduled to start fabrication on an industrial scale in the second half of 1979.
[b] Assistance by Saint Gobain Techniques Nouvelles.
[c] Co-operation between STEAG (FR Germany) and UCOR (South Africa).

Proliferation Act in order to ensure that countries importing US nuclear materials, technology and equipment meet the requirements set forth in the Act. The basic safeguards requirement is that non-nuclear weapon states submit all nuclear activities to IAEA safeguards. The demand is not tied to the NPT type of safeguards or to NPT membership. While the Act provides two years for renegotiation of agreements for cooperation, the full-scope safeguards requirement is to take effect on 10 September 1979, tempered by the President's authority to waive its application.

Spain is expected to readily subject its only unsafeguarded facility—the Vandellos power reactor—to safeguards. The reactor is operated jointly with France, where IAEA safeguards of civilian activities will take effect in 1979. In Egypt, the small Inshas reactor would have to be safeguarded, and some agreement found regarding the status of its

Table 5.4. Heavy water production capacities, excluding the USSR and China, as of 31 December 1978[a]

Country	Facility	Capacity (tonnes/year)	Technology	Contractor	First year of operation
Operating facilities					
Canada	Bruce 'A'	846	Water/hydrogen disulphide	Lummus/CGE	1973
	Bruce 'B'[b]	846	Water/hydrogen disulphide	Lummus/CGE	1978
	Glace Bay[c]	476	Water/hydrogen disulphide	Spevack-Burns & ROE/DCL	1976
	Port Hawkesbury	423	Water distillation–water/hydrogen disulphide	Lummus/CGE	1970
India	Nangal	14	Hydrogen distillation	Linde/DAE	1962
Israel[d]	–	Small scale	–	–	–
Norway	Rjukan/Glomfjord[e]	12	Electrolysis	Norsk Hydro	1934
USA	Savannah River[f]	180	Water distillation–water/hydrogen disulphide	Girdler-Lummus/du Pont	1952
Planned facilities					
Argentina[g]	–	2–3	–	–	1980
Canada	Bruce 'D'	846	Water/hydrogen disulphide	Lummus/CGE	1981
	La Prade[h]	829	–	–	1982
India	Tuticorin	71	Hydrogen/ammonia	GELPRA/DAE	1979
	Kota[i]	100	Water/hydrogen disulphide	BARC/DAE	1979
	Talcher[j]	63	Hydrogen/ammonia	Uhde/DAE	1980
	Baroda[k]	67	Hydrogen/ammonia	GELPRA/DAE	1979
Closed down facilities in countries other than those mentioned above[l]					
France	Toulouse	1.5	Hydrogen distillation	Air Liquide/CEA	1959
	Mazingarbe	26	Hydrogen/ammonia	Air Liquide CCM/CEA, SCC	1964
Switzerland	Domst-Ems	2	Water distillation–hydrogen distillation	Sulzer/Emser Werke	1960
FR Germany	Frankfurt/Hoechst	6	Hydrogen distillation	Linde/FWH	1958

[a] Soviet production may be some 20 tonnes/year. After the sale of 55 tonnes to India in 1976, the Soviet stock of heavy water is assumed to be small. China obtained a 6.5 MW(e) heavy water reactor from the Soviet Union in the second half of the 1950s. Presumably, it produces some heavy water; production capacity is, however, unknown.

[b] The Legislative Select Committee at Queen's Park has recommended mothballing the plant after the Porter Commission submitted that Ontario Hydro was heading for an overcapacity.

[c] The plant has been rebuilt. The original one started production in 1967, the rebuilt one in 1976.

(Notes continued overleaf)

[d] The facility may have been built in the early 1970s, as national control of heavy water exports got stricter. It is not known whether capacity has been sufficient to keep the Dimona reactor in operation after Norway declined further deliveries of heavy water in 1970.
[e] Actual production figure.
[f] In recent years, actual production has been about 1 tonne/year. It may be increased again depending on demand. The USA keeps a stock of 100–200 tonnes of heavy water.
[g] Following the pilot plant, Argentina plans a 250 tonnes/year industrial plant.
[h] Completion uncertain. The Canadian government has instructed Ontario Hydro to stop work at this point.
[i] Engineering work was affected by the strike at Rajastan in September 1977–January 1978. Production start-up may be delayed beyond 1979.
[j] The civil work has been completed. Pre-commissioning tests started in July 1978.
[k] Much delayed due to the accident on 3 December 1977.
[l] The list is likely to be incomplete. It is included for what it indicates about the spread of technology and production experience.

Abbreviations

CCM	Compagnie de Constructions Mécaniques et Procédés Sulzer (French)
CEA	Commissariat à l'Energie Atomique (French)
DAE	Department of Atomic Energy (Indian Government) (Indian)
DCL	Deuterium of Canada Ltd. (Canadian)
FWH	Farbwerke Hoechst AG., Frankfurt-Hoechst (FR German)
GALPRA	Groupement Eau Lourde Procédé Ammoniac (French)
SCC	Société Chimique des Charbonnages (French)

Sources: Annual reports for 1977–78 from Atomic Energy of Canada Ltd (AECL), and from the Department of Atomic Energy, India; *International Herald Tribune*, 17 October, 1978. See also sources to table 5.5.

Table 5.5. Fuel reprocessing capabilities, as of 31 December 1978[a]

Country	Facility	Type of fuel	Design capacity (tonnes of U per year)
Existing capabilities, commercial scale			
Belgium (Eurochemic Multinational)[b]	Eurochemic-Mol	Metal and UO_2, low enrichment, and metal, high enrichment	70 (plant closed down in 1974)
France (COGEMA)[c]	La Hague	Either metal, natural; or UO_2, low enrichment	2 000; start-up at 60 in 1976, increasing to 800 by 1980, by extension of existing capacity
	Marcoule	Metal, natural	1 000
FR Germany (GWK)[d]	WAK, Karlsruhe	Breeder, UO_2	40
India (IAEC)[e]	Trombay	Metal, natural	50
India (IAEC)	Tarapur	Metal and UO_2, low enrichment	125
Japan (PNC)[f]	Tokai Mura	UO_2, low enrichment	210 (limited by agreement with the USA to 99 over the 2-year period of the International Nuclear Fuel Cycle Evaluation)
UK (BNFL)[g]	Windscale Works	Metal, natural	2 500
Breeder fuel reprocessing facilities in operation			
France (COGEMA)	La Hague	Breeder (U–Pu oxide)	0.25 (pilot plant)
UK (BNFL)	Dounreay	Mixed-oxide fuels (from the Prototype Fast Reactor at the place)	5 (pilot plant)

Country	Facility	Type of fuel	Year available	Design capacity (tonnes of U per year)
Planned capabilities, commercial scale				
Argentina (AECA)[h]	Ezeiza	UO_2, natural	. .	. .
France (COGEMA)	La Hague	UO_2, low enrichment	1985	1 000
	La Hague	UO_2, low enrichment	1989	1 000
FR Germany (DWK)[i]	Gorleben	UO_2, low enrichment	1988–90	1 400
UK (BNFL)	Windscale	UO_2, low enrichment	1984	1 000
UK (BNFL)	Windscale	UO_2, low enrichment	1987	1 000
Planned breeder fuel reprocessing facilities				
FR Germany (GWK)	WAK, Karlsruhe	Breeder	. .	Cf. *Existing capabilities* above
India (IAEC)	Reactor Research Centre, Kalpakkam	Breeder (mixed oxide), thorium oxide	. .	Laboratory-scale. Cf. the Fast Breeder Test Reactor under construction at Kalpakkam

Country	Facility	Type of fuel	Status
Small-scale plants and laboratory-scale facilities built in countries other than those under *'existing capabilities'* above			
Argentina	Ezeiza Nuclear Center	UO_2, natural	Dismantled
Canada	Chalk River	UO_2, natural	Dismantled
Egypt[k]	. .	. .	Unknown
Israel	Dimona	Metal, natural	Unknown
Italy	DUREX-1, Saluggia	UO_2, and metal	Pilot plant (10 tonnes of U per year), currently closed down for modification
	ITREC-Rotondella	Thorium/uranium	Pilot plant (2 tonnes of U per year), in operation
Norway	Kjeller	Metal, natural	Closed down
Pakistan	. .	UO_2, natural	Unknown
Spain[l]	Juan Vigon Center	Metal, natural	Closed down
Taiwan	Institute for Nuclear Energy Research, Lung Tau	Metal, natural	Dismantled
Yugoslavia[m]	Boris Kidric Institute	Metal, natural	Closed down

[a] The WTO countries, the USA and China are not included. The only non-military US plant that has ever been in operation was closed down in 1972; its owners (Nuclear Fuel Services, Inc., of West Valley, New York) have since withdrawn their application to reopen. The Allied General Nuclear Services in Barnwell County, South Carolina, with a capacity for reprocessing 1 500 tonnes of oxide fuel per year, has not received a licence for operation. The reprocessing capacities of the USSR and China are not known.

[b] The plant was in operation from 1966 to 1974. Due to reprocessing of many different types of fuels, actual throughput has varied between 40 and 60 tonnes of U per year. Transfer to Belgian ownership has been negotiated, but no agreement is yet in force. Before Belgian takeover in 1982, plant modification may raise the capacity to 60–80 tonnes of U per year. A second line for reprocessing of oxide fuel (300 tonnes of U per year) has also been considered.

[c] COGEMA = Compagnie Générale de Matériaux Nucléaires, Commissariat à l'Energie Atomique (CEA).

[d] GWK = Gesellschaft für Wiederaufarbeitung von Kernbrennstoffen. Twenty per cent of the shares of GWK are taken up by the DWK (Deutsche Gesellschaft für Wiederaufarbeitung von Kernbrennstoffen GmbH), who will acquire all shares on 1 January 1979.

[e] IAEC = Indian Atomic Energy Commission. Will be modified and expanded to handle spent fuel from a 100 MW(e) research reactor (Super-Circus, Trombay).

[f] PNC = Power Reactor and Nuclear Fuel Development Co. Built by the French company Saint-Gobain Techniques Nouvelles. Following agreement with the USA, Japan has deferred the construction of the plutonium conversion facility scheduled to be attached to the plant. The parties to the agreement do not intend to undertake any major moves regarding additional reprocessing facilities for plutonium separation during the two-year period of the INF. A high-level radioactive leak in the evaporator section of the acid recovery system which occurred in October 1978 is likely to prevent the operators from reprocessing as much as 99 tonnes up to September 1979, as provided for in the agreement.

[g] A head-end facility for oxide fuel (LWR type) operated from 1970 to 1973, when it was shut down after a small release of radioactivity. Refurbishment of the oxide head-end seems unlikely.

[h] The plant has been described as an experimental one, to be built without foreign assistance. Construction was about to start at the end of 1978, and completion is scheduled for the early 1980s. Capacity figures have not been published so far.

[i] DWK = Deutsche Gesellschaft für Wiederaufarbeitung von Kernbrennstoffen GmbH, a joint undertaking of electricity utilities, previously Kernbrenns Wiederaufarbeitungsgesellschaft GmbH (KEW), a joint undertaking of chemical industries.

[j] The list is likely to be incomplete. It is included for what it indicates about the spread of reprocessing technologies to date. The technology transfer for the reprocessing plant to be built in Brazil as part of the West German–Brazilian deal (UO_2, low enrichment, 0.5–1 tonnes of U per year) has already been licensed by the West German government.

[k] Design capacity may be in the range of 0.5–1 tonnes of U/year. Operability and current status unknown.

[l] Express interest in future construction of reprocessing plants on their territories.

Sources: *Atomwirtschaft*, Vol. 22, January–December 1977; *Applied Atomics*, Nos. 1106–1155, January–December 1977; *Nuclear Engineering International*, Vol. 22, January–December 1977, in particular No. 258; *Nucleonics Week*, Vol. 18, January–December 1977; *Nuclear News*, *Present Situation and Future Programs for Reprocessing, Plutonium Handling and Recycling*, INFCE document WG. 4/31 (A,B), Revision 2, 16 November 1978.

laboratory-scale reprocessing facility. The three remaining countries with unsafeguarded facilities—India, Israel and South Africa—are unlikely to bow to the safeguards demand. The USA has already stopped deliveries of high-enriched uranium to the Safari 1 research reactor in South Africa. The fuel contract for South Africa's first power reactor at Koeberg, with the USA, has not so far been affected. Pakistan, which has two unsafeguarded laboratory-scale facilities, has no cooperation agreement with the USA.

However, *de facto* application of safeguards to all nuclear facilities on the territory of a non-nuclear state is not enough. The full-scope safeguards requirement also implies the legal obligation to declare construction activities to the IAEA for design review and subsequent application of safeguards in accordance with the NPT agreement, the IAEA full-scope model agreement, or some other type of arrangements. Non-NPT countries other than those mentioned above may therefore turn the full-scope requirement down as well. Argentina is a case in point. Whereas safeguards apply to all operational nuclear facilities on its territory, it has no legal obligation to declare purely indigenous activities and by the end of 1978 had not officially notified the IAEA of the construction of a fuel fabrication plant scheduled to start production in the second half of 1979.

The Non-Proliferation Act also defines a number of other conditions for the export of nuclear materials, some being similar to those agreed upon by the London Suppliers Group, others different. Among the most important ones are the requirements for prior US approval of reprocessing, enrichment, alteration and storage of materials of US origin. The London guidelines merely recognize the importance of mutual agreement on such matters whenever appropriate and practicable.

Canada and Australia require much the same safeguards and prior approval clauses as does the USA. The Australian agreement with Finland—which can be seen as a model agreement for Australian uranium exports—thus requires full-scope safeguards and prior consent for reprocessing, enrichment (to more than 20 per cent), and retransfers. To avoid the so-called 'double-labelling' problem—a situation in which fuel importers must live up to the export conditions of both uranium producers and uranium enrichers—the new US–Canadian cooperation agreement will leave it to the USA to handle these matters in consultation with Canada. The new US–Australian agreement may approach the problem of double-labelling in the same manner.

Unfortunately, the absence of a full-scope safeguards requirement in the London guidelines leaves the possibility of commercial competition between countries insisting on full-scope safeguards and countries that require the application of safeguards to the exported items only. As a rule, the former are also more demanding about other export conditions. Importing countries may therefore turn to European suppliers for technology and equipment, to South Africa and France/Gabon/Niger for uranium, and to Eurodif/Coredif, Urenco, and possibly the USSR for enrichment services. Accordingly, European countries may prefer Canadian, Australian, and US uranium for their domestic power programmes, so that enough South African uranium is available to support reactor orders from countries which do not fulfil the strictest requirements. This prospect is certainly noted by South Africa, which increased its uranium production from 5 400 tonnes in 1977 to 6 400 tonnes in 1978 (Namibian uranium included).

For Third World importers, therefore, the supply problem is not only a question of the adequacy of world production capacities, but to a large extent also a question of the availability of supplies. The reduction of nuclear power plans has to some extent alleviated the first type of concern. In 1978, therefore, the USA reopened its order books for enrichment services—and decided to delay the planned expansion of its enrichment capacity.[5] Buyers of new reactors can find ample supplies available from Department of Energy contract holders seeking relief. Urenco has also delayed its construction programme somewhat.

The availability of supplies as determined by the export policies has, however, become more of a problem. The USA is certainly not alone in sharpening export conditions. Additional conditions have also been negotiated between FR Germany, the Netherlands, the UK, and Brazil concerning Urenco's enrichment contract with Brazil. International control is required of any plutonium that might ultimately be separated from spent fuel of Urenco origin: if an international régime for plutonium storage is not established in time, the parties themselves will set up a multinational storage system. However, the conditions are different from those required by the USA—which could hardly be expected to allow reprocessing in Brazil at all—and the application for a construction permit for a third Urenco plant at Gronau, FR Germany,[6] can be seen as a hedge against further stiffening of conditions—in the Brazilian case advocated by the Netherlands. How far the USSR would go in selling enrichment services and other nuclear items is hard to

[5] If put into effect, the Department of Energy policies will postpone by two years the originally announced schedule for a gas centrifuge add-on to the government-owned enrichment facility at Portsmouth, Ohio; will defer the decision on building the new 9 million SWU gaseous diffusion plant proposed by Uranium Enrichment Associates; and will slow current improvement and uprating programmes at the three operating gaseous diffusion plants [5a].

[6] German utilities wished to secure their enrichment supplies against possible Anglo-Dutch intransigence by filing the application. Application for a construction permit does not, however, mean that any decision has been taken to go ahead with the plant: it is rather a precaution so that the field may be clear if in fact Urenco decides to proceed.

establish. Generally, however, the USSR has pursued a course of caution and restraint since the breach with China: power reactors have been delivered to NPT countries only, no enrichment or reprocessing technology has been transferred, and spent fuel of Soviet origin is returned to the USSR.

Being confronted with a combination of embargoes and transfer conditions which tend to involve foreign governments in the day-to-day operating decisions of their nuclear power organizations, non-aligned countries may also try to increase their nuclear self-sufficiency, following the examples of India and Argentina. They may increasingly seek national solutions to their fuel cycle problems, and turn to each other for mutual assistance. The proliferation implications of higher levels of nuclear independence are potentially grave. While the full-scope safeguards requirement is a welcome feature in the nuclear policies of supplier states, and universal adoption of this principle must be continuously urged, the unilaterally imposed export conditions that apply at present may have some unfortunate implications in the long run.

V. Nuclear power strategies and proliferation resistance

There are two main dividing lines in the debate on nuclear power policies. The conflict between suppliers or industrialized states and importers or Third World nations centres on export policies and safeguards regulations. The other controversy, between the USA on the one hand and Western Europe and Japan on the other, is a conflict of interest over the relative emphasis on military security versus energy security.

The US Non-Proliferation Act adds uncertainty to European and Japanese strategies of increasing energy self-sufficiency by means of reprocessing and fast breeder reactors. The Act can be seen as a comprehensive effort to use the present US domination of the world enrichment market to force extra controls on the use of nuclear materials. At the opening of INFCE, the USA pledged to make no changes in uranium supply procedures until the Evaluation was finished. The Act nevertheless defined a 30-day deadline for the cooperating parties to declare their readiness to renegotiate contracts which had been signed for periods up to the turn of the century. France, being relatively well off in terms of uranium supplies and enrichment capacity, blocked a joint European Community reply, and thereby sparked off an embargo on US enriched uranium deliveries in April 1978. The embargo was lifted three months later, upon an agreement which commits the Community to renegotiate the Euratom contracts on the condition that subjects being dealt with at INFCE will not be incorporated into the negotiations until the Evaluation is finished. INFCE actually includes all the main topics which the USA would like to raise with its European partners, so official negotiations are not likely to get under way until 1980.

The requirement for prior approval by the USA as regards reprocessing, enrichment or other modification of the form or content of nuclear materials of US origin, including materials produced by means of US technology, is likely to be the main topic of the negotiations. The case-by-case consideration of export licences for retransfer and reprocessing of fuel of US origin (the so-called MB-10s) practised so far is seen by many Europeans as a most blatant formula for uncertainty.

President Carter made it clear in April 1977 that those countries that were running reprocessing facilities had a perfect right to go ahead and continue with their own reprocessing efforts. He hoped, however, that they would join the USA in preventing additional countries from developing reprocessing capabilities. While the present British and French reprocessing plants at Windscale and La Hague are thus accepted—including, in reality, the plans for their refurbishment and expansion—it is hard to say whether the USA will license the use of FR Germany's planned integrated reprocessing and waste disposal site at Gorleben, Lower Saxony. The future of the Tokai Mura plant in Japan is also unclear. The US bargaining position is strong; it provides about 60 per cent of FR Germany's supply of low-enriched uranium, and 100 per cent of the highly enriched fuel for use in research reactors. Japan is even more dependent on US deliveries; at present, virtually all enrichment services required to operate Japan's 18 light water reactors are provided for by the USA.

Over the last year, the preoccupations with military security and energy security have remained basically the same. The once-through cycle in thermal reactors advocated by the USA as being the most proliferation-resistant alternative, is also the most wasteful one in terms of uranium resources; accordingly, the USA emphasizes that former predictions of nuclear power growth have been too high, and maintains that estimates of uranium resources have been much too low. Western Europe and Japan, advocating the case for fuel reprocessing and plutonium breeders, are more optimistic about the growth of nuclear power and more pessimistic about uranium reserves.

Largely catalysed by INFCE, however, a number of modifications have been suggested so as to make each strategy more acceptable to the other party. The US proposals aim at more effective utilization of resources, assurances of availability and arrangements for spent fuel storage. Western Europe and Japan have suggested ways to strengthen the proliferation resistance of reprocessing and breeders [7, 7a]. The novelty of INFCE is the introduction of proliferation resistance as a design criterion in the planning of fuel cycles. In the course of two years, however, only small modifications to proven concepts can be realistically assessed, since it is unlikely that a sufficient range of systems, covering all engineering factors, can be tested. The reactor concepts that survived in the past were those that, for a variety of reasons, received enough financial support to make the breakthrough to commercialization. They were not necessarily the best technological choices. Moving to increasingly expensive systems, and taking the whole fuel cycle into consideration, demonstrated alternatives are even less likely in the future.

There is widespread agreement that technical remedies to proliferation are a question for the next 20–25 years—not because the proliferation problem will disappear, but because the spread of expertise and equipment gradually renders technological fixes meaningless. Of the many proposals that have been registered during the first year of INFCE, few can have large-scale application within this time frame. Higher enrichment of LWR fuel and higher burn-up combined with a higher number of batches in the fuel cycle—one of the more promising ways of achieving more effective utilization of uranium (by about 15 per cent)—might thus be difficult to deploy on a large scale before 1995. For the breeder fuel cycle, the weak points are the reprocessing plant and the transport of large amounts of plutonium-bearing materials. Approximately 1 000 kg of plutonium is loaded into a 1 000 MW(e) LMFBR each year, and a somewhat larger amount is withdrawn. About 1 200 kg is in process, storage or transport in the fuel cycle for the reactor, as compared with about 250 kg in spent fuel for one gigawatt-year's operation of a once-through light water reactor.

The once-through fuel cycle may be more effectively enhanced by new institutional arrangements than by technical remedies. The attempt to establish an international uranium bank—a statutory obligation for the President of the United States pursuant to the Non-Proliferation Act—is gaining wider acceptance. The possibilities for international management and storage of plutonium and spent fuel are being studied both by the IAEA and at INFCE. Civilian-generated stocks of separated plutonium exist in Belgium, Canada, France, FR Germany, Italy, India, Switzerland, the UK, the USA, and the USSR (plus gram quantities in a number of other countries), and the stockpiles are likely to grow at some rate regardless of the choice of fuel cycles. Creation of 'plutonium mines' through long-term storage of spent fuels whose radioactivity, and thereby proliferation resistance, falls rapidly over

Table 5.6. Plutonium arisings in irradiated fuel

	1978	1985	1990
Accumulated commercial plutonium stocks (tonnes)[a]	125	240	580
No. of countries with plutonium arisings in irradiated fuel[b]	21	33	35
No. of spent fuel stores[c]	210	480	581

[a] Estimates for the market economy countries are taken from *International Management and Storage of Plutonium and Spent Fuel*, IAEA, 1978, using the reference case in that report. Estimates for countries with centrally planned economies are made according to their share of world nuclear-generated power accumulated up to 1978, 1985 and 1990, assuming that the ratio of actual production to design capacity is the same for the two groups of countries. Data on design capacities are taken from the IAEA's computer outprint on 'Power Reactors in Member States' as of 31 December 1978.

Due to uncertainties about the future pace and shape of nuclear power programmes, and to the crude nature of the estimate for centrally planned economies (for lack of relevant data), the figures are approximations subject to considerable uncertainty.

[b] Figures equal the number of countries having power reactors in operation by the end of the previous year (cf. note *c* below). Spent fuel stores at reprocessing plants or elsewhere are assumed to be located on the territories of nuclear power countries also for the future.

[c] The figures include the number of power reactors which have operated for more than 12 months, and spent fuel stores at reprocessing plants.

It is usual practice to unload some fuel from LWRs every 12 months. The number of stores at reactor sites are therefore assumed to be equal to the number of reactors which have operated for more than 12 months. No spent fuel is known to have been stored at more than one site, except for storage at reprocessing plants.

Away-from-reactor storage capacity exists at Windscale (UK), La Hague (France), Mol (Belgium), Tokai Mura (Japan), Tarapur (India) and at the G. E. Morris plant at New York (USA). They all contain some spent fuel, and are therefore included in the figures. Spent-fuel storage capacity is, moreover, contemplated by FIAT in Italy, and the USA is developing a new spent-fuel storage policy under which the US Government would accept and take title to spent fuel from domestic utilities. The same arrangement may be extended to other countries. New sites for storage of spent fuel are, however, not included in the figures for 1985 and 1990.

time is a growing problem [8]. For typical pressurized water reactors, the radioactivity of the fuel elements is reduced by a factor of 300 over the first years, and a factor of 2 000 over the first 10 years. By the end of 1978, accumulated plutonium arisings in irradiated fuel amounted to 125 tonnes, increasing to some 240 tonnes in 1985 (see table 5.6). Today, 210 spent fuel stores exist in 21 countries. On the crude assumption of one store at each reactor and reprocessing plant, there will be 480 stores in 33 countries by 1985. A legal basis for plutonium and spent fuel storage under IAEA auspices is to be found in article III and elsewhere in the Agency's Statute.[7]

The proposals for an international fuel bank and an international régime for the storage of plutonium and spent fuel seem to have better

[7] The Ford-Mitre proposals advocating the once-through cycle did so in the context that spent fuel would be returned to the USA. They did not consider the once-through cycle with spent fuel stored widely throughout the world. By giving only a vague commitment to accept return of spent fuel—a commitment which has not been implemented so far—the US Administration accepted one part of the Ford–Mitre proposal but not the other. There is a growing awareness, however, of the proliferation implications of 'plutonium mines'.

chances of realization than the more ambitious fuel cycle centre concept, and INFCE may be more successful in clarifying and promoting institutional approaches to non-proliferation than in devising technological fixes. The institutional approach may combine pragmatism with old vision in a process of gradual internationalization so that, in the end, everything but reactors is kept under international control: a Baruch plan applied to everything but reactors.

VI. The breeder controversy

Towards the end of 1978, informal talks between the USA and the other nuclear power nations were under way to explore the possible coexistence of different fuel cycle strategies in a form which enhances proliferation resistance without compromising energy security.

How far the USA will go in accepting reprocessing and use of plutonium in breeder reactors is unclear. So far, no conclusive record has been built through extension of MB-10s; they are granted primarily for lack of reactor storage capacity. Principal acceptance of existing breeder programmes has been clearly indicated, but Western Europe and Japan are asked to avoid the temptation to reduce unit costs by premature exports, and to limit commercialization to situations where there are compelling advantages; to design fuel-cycle facilities so that misuse is difficult and time-consuming, even if this involves additional costs; to make efforts to minimize flows of cold plutonium or fuels with high concentrations of fissionable materials, even if this adds to transport costs; and to make use of multinational arrangements where there are compelling reasons to proceed with new technology.

The US position on recycling plutonium in light water reactors is now clearer. It seeks a 10–20 year moratorium on such recycling, which it considers at best only marginally economical. A moratorium of this kind could, however, prove detrimental to the introduction of breeders. The reprocessing market would shrink; FR Germany and Japan might be caused to abandon their reprocessing plans, and total reprocessing capacity could be limited to the extent of creating a bottleneck for future introduction of breeders. Through such a limitation on reprocessing, breeders might therefore be inhibited even in circumstances which the USA says it will not oppose.

The USSR is siding with Western Europe and Japan in promoting plutonium breeders. In 1978, a cooperation agreement on breeder research between France and the USSR was signed providing for exchange of information and close cooperation on the Super Phénix and BN 600 breeders, following the exchange of documentation concerning Phénix and BN 350. Through cooperation with France, other West European countries are also involved in a pooling of experience with the USSR [5b]. On the other hand, Soviet positions on safeguards and export restraint are closer to those of the USA. Against this background, tight safeguards and export controls as a trade-off for a relaxation of attitudes towards existing reprocessing and breeder programmes have been suggested. However, the tightening of export conditions and safeguards regulations has been met with heavy criticism and resentment in the Third World, and the restraints on the use of plutonium would discriminate against them and put them at a double disadvantage—or so it would be perceived.

VII. The north–south perspective

At the insistence of non-aligned countries, the Programme of Action adopted by the UN Special Session on Disarmament underlines the inalienable rights of all states to develop nuclear power programmes in conformity with their own priorities, interests and needs. At the Meeting of Foreign Ministers in Belgrade in July 1978, the non-aligned countries agreed to draw up common programmes for future action in the UN and other international bodies, to coordinate their action, and to promote mutual cooperation. In December 1978, a 14-member coordination group met in Belgrade to prepare a more detailed programme of cooperation to be submitted to the non-aligned summit in Havana in 1979. Under the leadership of Yugoslavia, Pakistan and Nigeria, the non-aligned are also working to convene another international conference on the peaceful uses of nuclear energy which they would like to be political in character and serve to reaffirm article IV of the NPT. In the view of leading non-aligned nations, article IV has been undermined by the new export policies. These policies are, moreover, regarded as contrary to the whole concept of north–south cooperation, which is based on the widest possible transfer of advanced technology.

In the future, therefore, Third World nations—members and non-members of the NPT—can be safely assumed to voice a stronger and more unified criticism of the way in which the supplier countries are meeting their NPT obligations. Differences between national export policies—between the London guidelines and the stricter regulations applied by some suppliers—are of minor importance in this connection. These differences may be significant for the conclusion of business deals, but not for the political controversy between Third World nations and supplier states. Should nuclear policy become a standing issue of north–south confrontation, this might further erode the old, laboriously built consensus that there must be a steady, reliable functioning of nuclear supply mechanisms as a *quid pro quo* for the peaceful use of nuclear materials, technology and equipment under international safeguards.

As INFCE is coming to the end, and the second NPT Review Conference and another conference on the peaceful use of nuclear energy lie ahead, time seems ripe to reconsider supplier policies. The embargoes and restraints instituted over recent years have facilitated a much needed review of non-proliferation policies. However, in the history of international affairs, embargoes have often proved ineffective over the long term. It may now be time to reconsider the policy of unilaterally imposed restrictions, and prepare the ground for the negotiation of mutually accepted restraint. Consensus negotiations are difficult, but may yield better results in the long run.

References

1. Shelling, T. C., Testimony before the Subcommittee on Energy, Nuclear Proliferation, and Federal Services of the Committee on Governmental Affairs, US Senate, 95th Congress (US Government Printing Office, Washington, D.C., 1977).
2. The Nuclear Non-Proliferation Act of 1978, Section 307.
3. INFCIRC/254 (IAEA, Vienna, February 1978).
4. *World Armaments and Disarmament, SIPRI Yearbook 1977* (Almqvist & Wiksell, Stockholm, 1977, Stockholm International Peace Research Institute).
5. *World Armaments and Disarmament, SIPRI Yearbook 1978* (Taylor & Francis Ltd., London, 1978, Stockholm International Peace Research Institute).
   (a) —, table 2.4.
   (b) —, table 2.3.
6. INFCIRC/209, 1974.
7. *Nuclear Energy and Nuclear Weapon Proliferation* (Taylor & Francis Ltd., London, Stockholm International Peace Research Institute), in the press.
   (a) —, Farinelli, U., 'A preliminary evaluation of the technical aspects of INFCE'.
8. Marshall, W., Nuclear Power and the Proliferation Issue, Graham Young Memorial Lecture, University of Glasgow, 24 February 1978.

6. The expansion of naval forces

Square-bracketed numbers, thus [1], refer to the list of references on page 380. A list of acronyms and abbreviations appears on page 387.

I. Introduction

Problems relating to the oceans, to their natural resources and to the international régimes concerning the utilization of these resources occupy a high place among world issues. The ongoing Law of the Sea (LOS) Conference alone touches upon many basic national interests [1a]. However, the LOS Conference is not the only cause of the growing attention directed by states at the present and future role of the oceans in international life. Legal and economic considerations aside, it is the expansion of the naval power of states in virtually all regions of the world, anxious to secure their national interests at sea through the exercise of naval power, which is generating additional serious concern.

Naval power customarily plays major and different roles in international relations: on a global or on a regional scale, in time of war and in time of peace, as a tool of military action and as a tool of political coercion, and as a means of protecting states' rights and of enhancing their self-image. In the past decade nothing out of the ordinary has occurred to change this traditional pattern. However, new trends, both in the quantities of warships being procured and in the pace of their technological advancement, indicate that the naval arms race is more intensive than ever before. Together with the rapidly growing and so far disorganized dependence of mankind on sea resources, these trends, if not brought under control, are bound to have serious and unpredictable repercussions on international security.

Three areas of the arms race will be examined here. First, an overview of naval technological advancements, both in ship design and naval weapons, will be undertaken. Second, a rather concise comparison of the 'central' naval balance—the balance between the countries of the North Atlantic Treaty Organization (NATO) on the one hand, and those of the Warsaw Treaty Organization (WTO) on the other—will be made from the technological and numerical points of view. Third, and last, the fast build-up of the light naval forces world-wide will be taken up, with the aim of ascertaining its rate and scope. In this way, data will be provided on the present state of, and trends in, the world-wide naval arms race.

II. Technological advances in naval weapon systems

As in any other area of military technology, naval weapon systems undergo rapid change, resulting from general progress in electronics, construction materials, propulsion plants and engines. The new technologies amply provide both highly specialized weapons and many multi-purpose weapon systems.

Technological developments in shipbuilding

New technical possibilities and military requirements on the one hand, and the growing costs of procuring warships on the other, are dictating new solutions in the construction of warships. In particular, the cost factor places a restraint on the size, the number and the type of propulsion of naval vessels even in the case of the richest countries. This is understandable, considering, for example, that the unit cost for one nuclear-powered US aircraft carrier is of the order of $1–2 thousand million (including some $300 million in nuclear fuel) [2a]; for one SSN-688 'Los Angeles'-class submarine it is about $300 million; for one FFG-7 'Oliver Hazard Perry'-class frigate it is about $170 million; and for a DD 963 'Spruance'-class destroyer it is over $350 million (unit cost of four of these ships sold to Iran in 1978) [3, 4a].

The prohibitive costs of modern large-displacement warships impose on ship designers and users the necessity of seeking more economical solutions, generally speaking in the form of reduced displacement, yet high capability. In line with this trend, emphasis is here placed on examples of new technological concepts of such small vessels and on fast patrol boats (FPBs), the latter being an old class but with greatly increased combat capabilities. Other new concepts of warships, such as small and medium aircraft-carriers under discussion in the USA, or through-deck cruisers capable of air operation, developed in the UK [5] as well as new designs of patrol and strategic submarines of French, US or Soviet origin, are not discussed here.

Fast patrol boats

This type of vessel is the best example of how technology can offset the effects of current economic trends on warships, which force designers to produce ships of lower tonnage. An FPB costs about one-fifth of a missile frigate. Despite the smaller size of FPBs, their performance and strike power has been brought up to the former level of very much larger ships, such as frigates or destroyers [6a, 7]. According to some, the advent and development of missile-armed FPBs had as great consequences for naval warfare as did the application of nuclear propulsion to submarines. During the past decade these small but powerful vessels have rapidly spread to many regions of the world (see section IV).

There are, at present, three types of FPBs: small ones of up to 150-ton displacement, medium of 220- to 260-ton displacement, and large of 340- to 420-ton displacement [8a, 9]. Up to now the greatest number of designs have concerned craft in the middle group, although there has been a recent trend towards increased construction of large FPBs. This trend reflects the use of these craft both in combat and in long patrol duties at some distance offshore. Their capacity for taking large loads of weapons, connected with heavy fire control systems (FCSs), makes them more adaptable to different tasks in combat and leads increasingly to requirements for larger-sized ships. Thus, as in the case of other classes of ships, FPBs are evolving from small-size and single-purpose vessels to larger, heavily armed, multi-purpose warships. This trend is exemplified in the French Combattante III, West German Type 143, and Israeli 'Reshef'-class FPBs [8b, 10].

New FPBs have improved combat capability owing to the provision of better protection against nuclear radiation and chemical weapons, as in the Swedish Spica II and the two previously mentioned West German and French designs. Moreover, advances in gun automation and light modular designs of SAMs have, for the first time, given FPBs a good self-defence capability against air threats. The attainment of this capability by FPBs is remarkable [11a]. Thus, FPBs can now operate all types of weapon systems: torpedoes, guns, and various missiles—the make-up of the weapon suite being determined by the customer's requirements.

Hydrofoils

When speed is required, especially in rough seas, conventional displacement ships cannot match hydrofoil vessels, based on the dynamic displacement concept. These vessels are able to operate at speeds of 50–70 knots, and even in sea state 4–5 their speed is not substantially reduced. Moreover, at such speeds they have only 30 per cent of the vertical acceleration of conventional FPBs, which is caused by bouncing on waves. In addition, since roll and pitch angles are negligible, fire accuracy and weapon handling are vastly enhanced, not to mention increased endurance of personnel and materials. For the same speed, hydrofoils require over 65 per cent less weight of propulsion system than conventional displacement ships, leaving this space for the combat load. These craft are also cheaper to operate, consuming less fuel and being manned by smaller crews [8c, 12a, 13]. Among the disadvantages of this type of ship are much higher construction costs and vulnerability to damage, caused by foils impacting with floating objects at sea. It seems that after a long period of hesitancy about this type of naval craft, more and more navies will be operating these vessels. There are about 230 such vessels now in use in nine countries: 120 in China; 53 in the Soviet Union; 32 in Albania; 10 in Romania; 4 each in Pakistan, the Philippines and Tanzania; 2 in the United States; and 1 in Italy. The United States, Japan and Italy plan to procure more vessels of this kind. So far about nine different hydrofoil designs are operational, the Chinese 'Hu Chwan'-class and the Soviet 'Turya'-class vessels being the most numerous [14].

The high state of readiness of action and speed of hydrofoils complement the short reaction time of modern missiles. Although the majority of present-day hydrofoils are small-displacement ships, they serve as quite potent multi-purpose weapon platforms [15]. For example, the Italian PHM (Patrol Hydrofoil Missile), of about 60-ton displacement, carries an automatic dual-purpose heavy gun, two SSM Otomat. missiles and an electronic FCS. The latest Soviet hydrofoil of the 'Sarancha'-class, of 235-ton displacement, carries four SSN-9s, two SAN-4s and a 23-mm six-barrelled gun. Hydrofoils of such fire-power will substantially increase the combat potential of light naval forces in the close-to-shore waters. Moreover, projects exist in the USA for constructing much larger—well over 1 000- to 2 000-ton displacement—multi-role hydrofoils with ocean-going capabilities [4b, 16, 17a]. Hydrofoils can also increase the accuracy of fire of other more powerful ships by serving, in addition to helicopters and aircraft, as radar-pickets for OTH target acquisition and guidance of long-range anti-ship missiles.

Hovercraft

There are two different ways of utilizing static-lift vessels: air-cushion vehicles (ACVs) of up to 200- to 300-ton displacement for coastal and amphibious operations, and the so-called surface effect ships (SESs), with rigid side-walls, of 1 000- to 3 000-ton displacement, designed for a deep-ocean role. The first type is in development and operation in several countries. The second type is a US Navy project. Both utilize a cushion of air generated by fans thrusting downward and contained by a flexible skirt around (at the front and back for SESs) the lower part of the hull. Forward motion is secured by water- and air-jet propellers. Using this technique, the craft are able to move at speeds of up to 100 knots on calm seas. Each of these types of ship has distinct military potential.

The ACV is a full-skirt vehicle (around the hull), which may be used in coastal patrolling, as a missile-launching platform, in ASW and mine-countermeasure roles, and as an amphibious craft. In this last role it is superior to any conventional landing craft, which travel at speeds of about 10 knots and off-load over a forward ramp, by necessity often quite far offshore. The US project foresees such craft with 50 knots of speed for 60 tons of payload, able to run over 2.4 m of plunging surf, and over land to traverse slopes, trenches and rough terrain [18]. Such a multi-terrain capability would greatly facilitate amphibious operations. Because of the high speeds attainable, such operations could be launched from beyond the horizon, giving a bonus of surprise to the attacking side. These craft are easily used in conjunction with existing amphibious delivery ships, greatly enhancing the manoeuvrability and speed of action of modern marine forces.

Although there is widespread doubt as to the capability of air-cushion vehicles as weapon platforms, small hovercraft are already in use for attack and patrol duties in the Soviet, Polish [19], US, British, Iranian and Saudi Arabian naval and marine forces, some of them armed with missiles and guns [20].

A hitherto uncertain but often discussed application of these craft is their role in countermine warfare. Owing to their lower 'footprint' pressure and high speed, they are supposed to be more resistant to the effects of water-mines, and at the same time, when towing mine countermeasure devices, they can speed up anti-mine actions [21].

The large hovercraft, like the US SESs, are attractive for their speed and helicopter-carrying capability, both considered virtues in ASW. Such a SES frigate would speed ahead of a convoy, stop to listen for submarines and, with helicopter assistance, would track and destroy them [4b, 17].

Navies are reluctant to undertake serious deployment of hovercraft despite the above-mentioned attractions, the wide experience gained in using such craft for civilian transportation, and the indisputable advantages to be gained from using ACVs in an amphibious role [20, 22]. The reasons for this are the poor reliability of these vessels, the difficulties of counteracting air-skirt leakage, the sensitivity of the speed of the craft to rough seas, the high fuel consumption, and the high costs of construction. Thus, the practicality of large hovercraft in future naval battles is dubious. Even so, many states (USA, USSR, UK, France, Japan and Canada in particular) are carrying out vigorous construction of and research on these craft, and several other countries have already bought them for civilian or military use [20, 23].

Large ocean-going amphibious assault ships

Partly going against the general trend in naval shipbuilding towards smaller hulls, both the US and the Soviet navies are in the process of procuring large amphibious helicopter-equipped ships. The Soviet Navy operates the 14 000-ton Ivan Rogov amphibious assault ship, the first of its size in this fleet, able to operate in oceanic waters with landing craft, ACVs, helicopters and troop transports. It is well armed with SAN-4 missiles, several dual-purpose guns and a large rocket-launcher, presumably for giving fire-support to the landing force [24, 25].

The US Navy has received its third of five ordered LHA 'Tarawa'-class amphibious assault ships, each costing about $230 million. These carrier-like ships mark a further expansion of the US amphibious forces and are an important step in designing multi-purpose warships. The ship has a 39 300-ton displacement, and combines within one hull the operational capabilities of six different types of amphibious vessel: assault helicopter carrier, transport ship dock, landing ship dock, tank-landing ship, troop transport and attack transport ship. Thus, it will carry about 2 000 marines with all their artillery, tanks and vehicles, disembarking them on some 40 landing craft with a speed exceeding 20 knots on to the shore. The hangars on the ship can accommodate 20–30 helicopters (depending on type), and when required, the ship's deck is able to accommodate V/STOL aircraft, such as the AV-8A Harrier or even the older AV-10 Bronco types. The ship is armed with two eight-cell launchers of Sea Sparrow SAMs, and three 54-mm and six 30-mm guns [26].

New hull designs

As far as present-day technology is concerned, ship design has apparently reached the limit in two categories of performance: high speed and good sea-keeping, or sea-riding, quality [27]. Hydrofoils meet these two requirements with a large degree of success, but they have very short endurance and, moreover, their small size precludes their use as helicopter platforms.

The demand for a stable and relatively fast sea platform is met by the SWATH ship [17b]. This is a catamaran-like craft, with two submarine-like hulls below the water-surface, supporting the above-water structure (platform) on long thin struts. In this way, the parts giving it buoyancy are below the waves and the draught is kept to a minimum. The speed envisaged for this craft is similar to that of any modern conventional displacement ship—about 30–40 knots [28]. Owing to its construction features, SWATH remains stable at all speeds and in rough seas. This quality makes it superior to any but the largest ship platforms. The rapid movements of conventional ships exposed to high waves drastically impair the action of all weapon systems, fire control radars, and hull-mounted sonars (when they emerge from the sea), and restrict, completely at sea-states over 4, the action of helicopters. Apart from its excellent sea-keeping, SWATH's construction provides much greater deck area than any ship of comparable displacement, which is half that of modern destroyers. Even so, it will permit substantial air forces to be located on it, including operation of V/STOL aircraft.

Apart from SWATH, several other design concepts are being studied in the USA. They consist of different hybrids between SWATH, hydrofoils and air-cushion vehicles, able to meet various specific military requirements and to alleviate various operational constraints, typical for more conventional ships [17c].

Trends in ship construction

Since the first priority of warship designers is to make provision for equipping the vessels with the most powerful weapons possible, given their operational tasks and size, great care is taken to save space and weight by appropriate construction and the use of special materials. Thus, all-aluminium hulls have been developed for frigates, FPBs, hydrofoils, SESs and ACVs. Various compositions of graphite, boron, glass and wood are widely used. Fibre-reinforced plastic hulls are used for minesweepers and minehunters, since such material is non-magnetic. Much research effort is put into finding better steels, especially for the construction of new submarines [17c, 22, 29].

A modern destroyer has as much as 300 km, and a cruiser 400 to 520 km of wire and cables for various signal transmissions. The reduction of numbers of types of different cables, and of their length and weight, is therefore one of the more serious problems in ship design. A major advance in this respect is under way by application of the Shipboard Data Multiplex System (SDMS). The concept of SDMS is based on the use of coaxial cables, in which time-shared frequency multiplexing occurs, able to handle a variety of signals through a common line. By the application of SDMS, shipbuilding and overhaul costs will be lowered and better flexibility in ship design achieved; the weapon suite on newly constructed warships can be decided later in the construction cycle, permitting the installation of more modern systems; installation flexibility on the overhauled ships will be increased, and overhauling will be less costly owing to diminished destruction of former wiring; and the combat resistance of ships will grow, since if one set of cables is destroyed, others can deliver the message [17c, 30].

At present only some 25 per cent of signal transmissions can be multiplexed; research is proceeding with a view to further expansion of the technology, especially with the use of fibre optics.

Another rapidly developing technology is the modularization and size standardization of weapon systems and associated equipment. This also permits the saving of space and the quick exchange of weapon suites.

Militarization of merchant ships

Utilization of merchant ships for military purposes is a long-time practice as far as fuel and material replenishment of warships or transport of military personnel and equipment is concerned. A completely new trend is arising, however, with the proposals for militarizing merchant ships by providing them with self-defence and ASW offensive/defensive capabilities. Thus, in addition to programmes aimed at increasing the usability of tankers and other ships for military sea-lift and underway replenishment, programmes exist for initially installing helicopters, and later on ECM equipment, close-in weapon systems, torpedoes and missile launchers. Since it is not easy to make structural changes to merchant ships, other technological solutions have had to be found.

The first example of militarization of merchant ships is a system called the Arapaho containerized helicopter facility. This consists of a rapidly installable ASW helicopter carried in standard containers with complete flight deck, hangars, crew quarters, galley, fuel, ammunition, power supply and repair equipment. Armed with this weapon system, merchant ships are presumed to be able to threaten submarines, thus increasing their own survivability in time of conflict. After the concept of helicopter containerization has been tested out, the same could be done with V/STOL aircraft, giving merchant convoys longer-range reconnaissance, early-warning and interception capability against air threats. Further, ship defence could be expanded by vertically launched anti-ship, anti-aircraft and anti-submarine missiles, as well as by automatic guns, ECM equipment against enemy guided-missiles, and all necessary command, communication and control facilities. Another militarization concept is the so-called Lighter Aboard Ship (LASH), carrying various small vessels, such as ACVs [17d, 31, 32a].

Technology of naval weapon systems

The purpose of this subsection is merely to point out the most conspicuous trends in weapon technology, without attempting a thorough discussion of the problem or a comprehensive listing of all the systems now available. A compilation of such data may be found in several other sources [9b, 14, 33, 34a, 35–38]. Together with the discussion of new types of hardware, or weapons, several other issues, such as distant targeting, surveillance and developments in FCSs, will also be mentioned, since they have a strong influence on the effectiveness of naval weapons.

Ship-to-ship missiles

These missiles were developed as far back as the mid- and late 1960s by both the Soviet Union and the United States. However, the latter, after R&D work on the Navy's Regulus and Matador missiles (and the Air Force's Shark, Bomarck and Snark missiles) aborted these efforts in view of the existence of strong Soviet anti-air defences and the inferior qualities of these weapons in comparison with ballistic missiles [39a, 40]. The Soviet Union has continued the development of a panoply of anti-ship missiles and procured them in large numbers. They are installed on most Soviet warships, including small FPBs. This type of naval weapon proliferated later on both in design and in number, and they are now in the inventories of several navies, large and small alike [35].

Although as many as nearly 20 different SSM designs were elaborated by eight countries, it is only now that full advantage can be taken of the new propulsion, fuel, guidance, launching and warhead technologies. The new generation of anti-ship guided missiles is exemplified by the US Harpoon RGM-84A and tactical Tomahawk BGM-109 missiles. Both of them are multi-purpose and multi-platform weapons, the first already deployed on several surface, sub-surface and air platforms, and the second in the final stages of development. Though they can be launched from different platforms, the main mission is, however, a surface or sub-surface anti-ship one. Since both can be launched from a conventional torpedo tube, they can potentially be deployed on all types of submarine.

The Harpoon was first deployed in 1977. Its basic surface-launched version is over 4.5 m in length and weighs over 660 kg, together with solid propellant booster (surface and sub-surface versions). Its high-explosive warhead of 225 kg is of the blast penetrating type (although a nuclear warhead can be installed). It has a range of 90–110 km, which is well over any ship's radar horizon. It incorporates two kinds of propulsion and guidance systems: at first it flies under pre-programmed, on-board computer-controlled inertial guidance, being propelled by a solid booster motor; afterwards, it descends to a low cruise altitude determined by a radar altimeter, and is propelled by a turbojet engine. In the final stage of its flight it pops up to out-manoeuvre the target's defences and homes on it using an active radar seeker. Throughout its flight it has a subsonic speed of Mach 0.75–0.8 [41a, 42].

The second of the new US guided missiles is a naval tactical version of the strategic cruise missile (ALCM). Tomahawk is an extremely versatile weapon, owing to the modularity of its design. This design permits emplacement of either a high-explosive or a nuclear warhead, and attachment of a rocket booster for underwater launching. It can be placed on any launcher compatible with Harpoon and in a torpedo-size tube. Apart from a main anti-ship version, under-keel (under-ship), anti-shore and ASW versions exist. Additionally, this missile can be used as an OTH RPV to help in guiding other missiles, and also as a surveillance and reconnaissance RPV. All of them are encapsulated [39b]. Tomahawk is over 6.1 m long, has a diameter of about 0.55 m, weighs 1 080–1 215 kg, utilizes a semi-armour-piercing 475-kg warhead of the Bullpup-B ASM or a shape-charge warhead in the under-keel version [43]. Like Harpoon, it is at first propelled by a solid-boost engine, but unlike Harpoon, the cruise phase is supported by a turbofan engine. This feature permits its launch from a submerged submarine, and together with a larger fuel volume gives it a much longer range—up to 450–550 km—and because the thermal efficiency of this engine is higher than that of a turbojet, the exhaust gases have a substantially lower temperature (450°C less) and thus the missile has a very small IR signature [44]. Its surface is to be covered by special coating in order to reduce its radar cross-section to a bird-like size, or 0.05 m^2. For these reasons, it will be difficult to detect its presence from long distances and it will be less vulnerable to IR-seeking air-defence missiles. Therefore, to counter Tomahawk will be difficult, despite its subsonic speed of Mach 0.7. An advanced Harpoon system is used to guide it, and a similar low-level flight of 10–15 m over the surface is envisaged. It can, however, climb up to several thousand metres when a high/low profile of flight is needed to extend its range, and in its under-keel version it is able to dive and explode under the attacked ship.

When Harpoon and Tomahawk become fully operational on the US and other Western surface ships, submarines and aircraft, these navies will acquire tremendous offensive capability [45]. Since each US SSN submarine has a limited space for weapons, such as Harpoon, Tomahawk, various torpedoes and SUBROC, it may be assumed that a high percentage of this space (depending on a submarine's patrol mission) will be used to store the modern guided missiles. With these missiles on board, each vessel will possess an offensive capability similar to but smaller than that of an aircraft carrier. Hence an adversary would be forced to conduct operations in some degree comparable to anti-carrier operations against a great number of warships.

Although the Soviet Union pioneered the operational use of SSMs, or perhaps just because of this fact, its SSM technology seems to be lagging behind the US designs. The most numerous Soviet long-range anti-ship missile, the SSN-3 Shaddock, installed on five different classes of submarine (Echo I and II, Whisky Long Bin and Whisky Twin Cylinder, Juliet, the last three conventionally propelled), as well as on two classes of cruiser and on some destroyers, has been operational since 1962. It is enormous in size (length about 11 m), and although it is believed to reach distances of about 450 km, it needs mid-course guidance from an auxiliary platform (aircraft or ship) if it is to be accurate. Only in recent years has its advanced version (SSN-12) appeared on 'Echo-II'-class submarines and 'Kiev'-class helicopter carriers, exhibiting, however, the same drawbacks of large size and need for mid-course guidance. Both are supersonic, Shaddock probably of Mach 1–1.5, and its newer version probably of Mach 2–2.5. Both can only be launched from surfaced submarines, thus revealing their presence to modern surveillance sensors. One presumed advantage of the SSN-12 is that it is supposedly capable of high-altitude flight well over 10 000 m. Undoubtedly, a missile flying so high is more easily detected by radars than one approaching at very low altitudes, as in the case of several Western 'sea-skimmers' and the US cruise missiles described above, but, at the same time, once the missile has arrived safely over the target and has begun to dive on it, it would probably be difficult to destroy it. Since both versions of Shaddock are probably nuclear-armed, they do not need to be extremely accurate in order to be effective.

The only Soviet guided missile which can be launched from a submerged submarine is the SSN-7 missile, first deployed in 1969–70 on 15 'Charlie'-class and 2 'Papa'-class nuclear submarines. This missile reaches a supersonic speed of Mach 1.5 and is said to have a range of 45–50 km.

Of the 10 or so designs of Soviet SSMs, only two appeared relatively recently: the SSN-9, fitted to 'Nanuchka'-class corvettes, operational in 1969, and its range being confusingly estimated in a variety of ways from 48 km to 240 km; and the SSN-11, considered an advanced version of the well-known SSN-2 Styx, fitted on new 'Osa'-class FPBs, and covering a range of up to 40 km. Both are believed to be subsonic or trans-sonic, propelled by a solid booster with radar homing guidance. The Soviet cruise missiles may be considered a potentially serious threat even to a navy equipped with many advanced air-defences. Large numbers of Soviet missiles are believed to be armed with nuclear warheads. They are often supersonic, but probably none of them is able to fly at very low altitudes. Only 17 of all 72 Soviet submarines armed with guided missiles were built after 1969 and were fitted with modern SSN-7 missiles, permitting launch when submerged.

West European navies started developing SSMs in the early 1960s. So far about 15 designs have been developed by France, Italy, the UK, Israel, Norway and Sweden. In the case of the UK, the SSMs are dual-mode SAMs (e.g., Sea Cat, Sea Dart or Sea Slug). These SAMs have proved to be successful in both roles, and therefore no SSMs have been designed in that country.

Recent advancements in the West European SSM technology can be summarized as follows: extended ranges, variety of HE armour-piercing warheads, sea-skimming capability, various and accurate guidance systems. One example of this evolution is the French Exocet MM 40. Its present range of over 70 km is nearly twice as large as that of the earlier MM 38. Similarly, Israel's Gabriel II has double the range of its first version (41 km). The majority of SSMs are guided inertially, by autopilot/command, or by optical systems, and attack a target using semi-active homing radar or IR homing devices [46]. Several of them can be stored in containers, which may serve as launch tubes, thus permitting easy installation on different-sized decks and facilitating maintenance. All of the currently deployed Western missiles are subsonic. Only France is planning to develop submarine-launched anti-ship missiles, using the Exocet technology.

In addition to the existing anti-ship missiles, quite a new programme has been initiated by six NATO states—the USA, the UK, FR Germany, France, the Netherlands and Norway. This missile, called the NATO supersonic missile (ASSM), will utilize integrated rocket and ramjet propulsion technology. The ASSM will have a range of nearly 200 km, sea-skimming capability, a speed of Mach 2–2.5, inertial navigation in the cruise part of flight, and dual radar or IR homing in the terminal phase of attack.

Over-the-horizon targeting

One of the frequently mentioned features of many modern SSMs is their capability for striking from beyond the horizon, that is to say, before the target radars can detect their launching. This advantage is, however, difficult to exploit, since the radar or acoustic sensors of the attacking ship or submarine are too far from the target to be effective. Thus, target acquisition—that is, obtaining its location, speed, direction and size, and identifying it—is a primary condition for the effective action of long-range SSMs. The optimum situation arises when the reconnaissance and data-relaying station is located between the firing ship and the target. This is, however, difficult to attain, since the relaying station is bound to be exposed to counterfire. Moreover, not many countries possess the advanced technology required for the deployment of highly sophisticated long-endurance RPVs suitable for relaying target data.

The Soviet Union, until recently operating the largest number of guided missiles requiring mid-course guidance in distant engagements, has developed a large number of long- and medium-range maritime reconnaissance bombers with search radars and other electronic equipment which can be used for supplying targeting data for SSMs, such as the SSN-3 Shaddock missile [49]. A possibility—doubtful, although sometimes mentioned—is that the new Soviet maritime supersonic reconnaissance bomber, the Tu-26 Backfire, may have a role to play in target acquisition and missile guidance.

In view of the growing vulnerability of air, surface or sub-surface reconnaissance platforms, it must be presumed that the role of ocean surveillance satellites in providing such data will be expanded. This is plausible, given the usefulness of satellites in ocean navigation; in collection and dissemination of data on weather, sea state and presence of surface ships over vast areas of ocean; and in providing communication between various ships and command centres. If it is true that Soviet ships operate with restricted capability for inter-ship exchange of combat data, then satellites for naval strategic and tactical command would be especially attractive for the Soviet Union. However, satellite communication equipment is very costly, and only capital ships, such as 'Kiev'-class helicopter carriers or 'Sverdlov'-class cruisers (flagships), are presumed to be fitted with such facilities [14, 50]. Several Western authors claim that the Soviet Union is highly advanced in satellite maritime surveillance technology. This is, however, doubtful. In the past decade the Soviet maritime satellites have operated in pairs for only 60 days per year, making a pass over the same spot on the ocean surface about every six hours. During these six hours a modern ship making over 30 knots would have changed its position by more than 300 km. The short duration of Soviet maritime surveillance and other technical features of the Soviet satellites clearly show the rudimentary nature of the programme. Moreover, since the Cosmos 954 catastrophe no further ocean surveillance satellite has been launched (see chapter 4, section III). However, this set-back need not prevent Soviet space naval surveillance from becoming much more capable in the future.

Similar problems with remote target acquisition are confronting other navies operating guided missiles with over-the-horizon range. Highly useful for such target acquisition are air surveillance platforms, such as AEW aircraft, helicopters and RPVs; hence they are being intensively developed. The most comprehensive programme for the development of OTH targeting capability has been undertaken by the USA. In the words of the Director of the US Defense Research and Engineering: "With Harpoon in the operational inventory and Tomahawk under development, it is imperative that practical targeting techniques be developed . . . " [52a]. Accordingly, various surveillance sensors and systems for efficient command and control dedicated to acquire and transmit surveillance data to naval tactical commanders in real-time and with high accuracy are under study in the United States. Fleet exercises for this purpose were carried out at first in 1976 under the name of Project Outlaw Hawk, experimenting with shore- and ship-based correlation equipment. In 1977 another project, called Outlaw Shark, was carried out, correlating surveillance data from large numbers of sensors to naval commanders and to a submerged submarine via the Submarine Satellite Information Exchange Sub-system (SSIXS) [52b, 53]. In the exercise, which covered large areas of the Mediterranean Sea, data from satellites and aircraft were delivered through computer-to-computer linkages to the submarine, allowing it to identify all ships in this vast area and to fire at a single Soviet ship present there. A Tactical Surface Surveillance project was initiated in 1977 as a follow-up to these exercises in order finally to formulate an ocean-surveillance master plan, which would include all sub-surface, surface, air, and space-surveillance systems. In this way, both world-wide and local-area systems will be established, the former providing data to be concentrated upon by the latter. Altogether, 14 different US technical programmes can be distinguished in connection with the expansion of OTH targeting capabilities. They include the afore-mentioned ocean-surveillance master plan; the advanced light airborne multi-purpose system (LAMPS III); various aircraft-borne systems for early warning, surveillance, interception and identification of radar and other electronic signals in addition to tactical airborne signals exploitation systems (TASES), consisting of several sensors in a carrier-based A-3A aircraft for close-area surveillance and targeting; Fleet Command Center (FCC) and Tactical Flag Command Center (TFCC) for integration and dissemination of information on targets [52c]; the 'Clipper Bow' system, a highly secret navy radar satellite, able to perform all-weather detection of surface vessels over large areas and tell their exact location by use of high-resolution radar, to be operational by about 1985 [54, 55]; advanced mini-RPV for day and night observation, identification, transmission of targeting data, laser illumination and post-damage assessment, to be developed in 1982–83 [41b]; improved towed acoustic arrays for surface ships and submarines; and, finally, a world-wide system for correlation, evaluation, analysis, and spread of information on targets, that is, the ocean surveillance information system (OSIS) [56]. Outside this coordinated effort is the development of the E-3A aircraft, which in 1979 is to be tested with new equipment giving it over-the-water capability for detecting slow-moving ships [57, 58].

The sophisticated means of OTH targeting are, as far as accurate firing of missiles is concerned, closely linked to the existence of equally sophisticated means of accurate navigation, such as the currently used ground-based Omega navigation system, giving the exact position of a ship. Equally important is the development of efficient communication systems, allowing the transmission of huge amounts of data in a matter of seconds. These requirements of the 1980s will be met on the Western side by the development of the NAVSTAR GPS system, 24 satellites of which will permit an unlimited number of ships and aircraft to ascertain their locations with an accuracy of up to 5 m horizontally and 7 m vertically, their velocities to within one-tenth of a nautical mile per hour, and the time to within one-millionth of a second. In contrast to the Soviet uncertain satellite communication capabilities, US satellite communication is now secured by the present third-generation FLTSATCOM system, and will be secured in the future by the LASERATCOM system with a capability of handling some 40 000 voice channels and 12 colour-TV channels simultaneously [59, 60].

Air-to-surface anti-ship missiles

As in the case of ship-launched missiles, the large-scale operational development of air-delivered anti-ship guided missiles took place first in the Soviet Union. A family of ASMs appeared there in the early 1960s, all of them having long or very long range (over 300 km) and being of rather simple design. All were of large size, like the AS-3 Kangaroo missile of over 15 m length. Somewhat later came the AS-5 Kelt missile. Several thousand ASMs, particularly the AS-4 Kitchen and AS-5 Kelt, are believed to have been produced. Hundreds of them have been deployed on various Soviet long-range bombers.

Sparse news has been received in recent years about one or two new Soviet ASMs, given the designation AS-6. This missile is believed to be capable of over 200-km range on high-altitude, supersonic, inertially guided flight, and of diving on a target with the help of a radar homing device. It is carried by the Soviet Tu-26 Backfire bomber.

There now exist about 20 Western ASM designs [42]. They can be divided into light-weight helicopter-launched missiles, such as the old French AS.12 and the new AS.15, the Italian Sea Killer, or the British

Sea Skua, and aircraft-carried, like the West German Kormoran AS-34, the Anglo–French Martel AS.37/AJ.168, or the Norwegian Penguin. Several types of missile can be mounted on both these types of platform, for example, the French–Italian Otomat and the French Exocet AM.39. All these ASMs have ranges, from 10 km (French AM.10) to 20 km (Penguin, Sea Killer), up to stand-off and OTH ranges of 45 km (Kormoran AS.35), 60 km (Martell AS.37), and 80 km (Sea Skua, Otomat). These ranges permit the firing air-platform to stay well beyond the attacked ship's retaliatory capability, especially when the ship is only gun-armed. Nearly all of these missiles are 'sea-skimmers', sometimes having a capability for climbing up and then diving on the target. During the cruise phase their guidance is either inertial or by radio command.

New technological developments are constantly taking place in the area of guided missiles. Thus, several modes of guidance, passive or active, or optical homing, are being incorporated into one missile, as in the case of the Kormoran; an all-weather and day/night capability is being attained in, for example, the French AS.15 or the new Anglo-French P3T sea-skimming missile; a warhead of special design (like that fitted to the Kormoran) is being used, able to enter a ship without causing major damage and to detonate later by the action of an impact fuze with pyrotechnic delay, then exploding inside the ship and destroying its vital parts with high kinetic-energy projectiles; and laser-guided weapons, like the French AS.30, are being developed.

The newest in this family is the Japanese-built ASM of 45-km range.

The first US ASM, Bullpup AGM-12, was developed in 1959 and represented a high level of technology owing to its Mach-2 speed and its multi-mode configuration. Later appeared the Condor AGM-53A, electro-optically guided with great accuracy over 60–80 km, and also having supersonic cruise capability. Condor, although judged a highly successful design in 1975, was discontinued in 1976 ostensibly because of its high costs, but a more important reason was probably that a new generation of ASMs, exemplified by the Harpoon missile, seemed more attractive. At present, the US ASM arsenal consists of the Harpoon AGM-84A, Maverick AGM-65 and differently guided bombs of GBU-15 and Walleye AGM-62 types. Four of the several versions of Maverick have anti-ship capability: laser Maverick (LMav–AGM65C) with 125-kg warhead; IR Maverick AGM-65D with imaging IR (IIR) system giving day/night capability; Mk.19 with fragmentation warhead and guided by either laser or TV or IIR system; and, finally, a 'blast enhancement' version with a bigger warhead capable of destroying larger ships [48b]. The Harpoon missile, described in the preceding subsection, is expected to become the most widespread anti-ship weapon in the West. By 1982 over 2 100 missiles are to be produced for US aircraft, helicopters, ships and submarines, and an additional 1 685 have been ordered by other countries. As US Secretary of Defense D. Rumsfeld stated, the Harpoon missile on an A-6E carrier-based attack aircraft of about 1 600-km range (nearly twice as much according to other sources) "will far outrange even the most advanced Soviet anti-ship missile" [61]. However, the list of operational US ASMs will soon include additional weapons. The new high-speed anti-radiation HARM AGM-88A missile will be developed as a replacement for earlier Shrike and Standard ARM missiles. In addition to very high speed, the new missile will possess a more destructive warhead and the latest ECCM suite. It will permit US aircraft to react more effectively against radar emissions directed against them. Another new development is the Integrated Rocket Ramjet programme, which will soon lead to the development of several projects, such as an advanced beyond-visual-range intercept missile (of Mach-5 speed), a long-range SSM, an advanced strategic air-launched missile, and also a supersonic tactical ASM [41c, 62]. The entire integrated programme is based on Low Volume Ramjet (LVRJ) technology, where a solid-propellant motor boosts the whole unit to a certain speed, the empty motor case then being used as a combustion chamber to burn fuel for long-range high-speed flight under ramjet propulsion; this technology is believed to be applied in the already operational Soviet SA-6 Gainful missile. These new technologies, together with an advanced inertial guidance system, will bring about single-shot 'kill probabilities' against ships and increase the potential area of naval combat and the speed with which it is carried out [42, 64].

Defence against anti-ship missiles

Since anti-ship weapons are launched from several different types of platform, defence against them comprises two consecutive steps: first, the platforms (submarines, ships and aircraft) are sought out as far away from one's own ships as possible and are then attacked, mainly by sea-based aircraft, to prevent them from launching their missiles; and second, the oncoming missiles are fired at by all available means. The first task is complicated by the variety of the platforms; anti-submarine warfare requires quite different tactics and weapons as compared with anti-aircraft or anti-ship operations [65].

The growing threat from anti-ship guided missiles has spurred the development of a wide range of highly automatic, quick-reaction defence systems. The increasing speed of anti-ship missiles allows little time for accurate counterfire. In order to overpower a well-defended target, the attacking side must obviously aim at saturating the defence by a multiple and probably omnidirectional mode of attack. FCSs for anti-missile defences are accordingly much more sophisticated (and heavier) than those controlling attacking missile systems [66].

The characteristic feature of all Soviet naval SAMs is that they are identical or very similar to ground-based SAMs, both in weapons and in fire controls. The latest one is the SAN-4 missile, placed on several classes of ships, from 'Nanuchka'-class corvettes to aircraft-carriers. About 160 SAM launchers have been installed on Soviet ships, the most widespread missile system among them being the old SAN-1 Goa twin-launcher.

SAM systems were introduced into US ships about 1956, some seven years before this happened in the Soviet Navy [67a]. The USA and its West European allies have developed many different missile systems and supporting fire-control equipment. The Western air-defence missiles and weapon systems can be divided into the medium- or long-range area-defence systems and point defences, the latter consisting of short-range missiles, small-calibre rocket systems and guns.

The area-defence missiles are the oldest US Terrier RIM 2A/F beam-rider, of which the RIM-2D version has a nuclear warhead, of 35-km range; the Tartar RIM-24 of about 16-km range; the Talos RIM-8A/J 120-km range conventional or nuclear-armed missile. All three are supersonic [68]. The first two are to be replaced by Standard SM-1 missiles, of which the medium-range (MR) version reaches 18 km, and the extended range (ER) version reaches over 48 km [61d]. The West European area-defence missiles can be exemplified by the British Sea Slug of 45-km range, operational as early as 1961, the French Masurca of 45-km range, and the Italian Albatros system, using an Aspide multi-purpose missile of about 25-km range [38b]. The new generation of area-defence systems is designed to have a capability for simultaneously engaging a number of targets, a feature depending firstly on the sophistication of FCS and on the number of radar-illuminating systems, and secondly on the quick reaction of the missiles themselves. One example of this new generation of missiles is the British Sea Dart, able to engage a number of very low as well as very high flying aircraft and missiles at 30-km range. In the USA an improved area defence weapon system is the Standard SM-2 missile, with a more than doubled range of 48 km for its MR version, and over 100 km for its ER version, with two-way link, mid-course command guidance, and a new digital on-board computer, and with better resistance to ECMs.

Along with the new weapons for area defences, the fire control surveillance and tracking, and command and control systems are maturing quickly. A system being developed for the 1980s in the US

Navy is the AEGIS FCS. Apart from a missile (such as SM-2), it consists of a modern multi-function, phased-array radar for target detection and tracking, numbers of radars for target illumination, several computerized subsystems for control of different weapons (missiles and guns), and an automatic multi-purpose launcher. The target image is obtained from the system's radar as well as from the ship's other sensors, or from other ships and aircraft [69a]. In order to make it possible to overpower ships equipped with AEGIS, several billions of dollars would be needed solely for the development of new, more capable missiles, not counting their deployment [41e]. AEGIS will be linked with NTDS, which will allow well-coordinated defence of a group of warships despite adverse weather, electronic jamming and multiple-missile attacks [67c].

Since the area anti-missile defence can fail, several close-range, or point-defence, weapon systems have been developed. There is a divergence of opinion on whether missiles or naval guns are better suited for point defence. Despite this controversy, both missiles and guns are now considered indispensable for ship defences.

One of the earliest systems for point defence was the British Sea Cat close-range missile. Now a large family of new generation SAMs is available [38b]. One is the Sea Wolf missile, in different versions, with all-weather performance, capable of defence against very low up to steep angle of attack, fully automatic, guided by 'command to line of sight' (CLOS), and automatically measuring any angular offset between the missile and target sightline [8d]. Another example is the Sea Sparrow point-defence system with an AIM-7E missile, now in several versions, with sea-skimming capability. One such version, the RIM-7H, installed on a light-weight 8-tube launcher, was modified under a common NATO programme and introduced into operational service in 1973.

A general trend, indicating the growing desire to adapt the heavy electronic and weapon load into small vessels, is to make the point defences lighter and more compact [38c]. Several systems have undergone such modification, such as the old-fashioned Sea Cat missile system, with a much lighter 3-round launcher. The same was the case for the visually guided light-weight versions of the Sea Wolf missile, some of them to be mounted on FPBs [70]. This trend provided even submarines with an anti-air capability. The surface-launched air missile (SLAM) is a British system, using a light Blowpipe missile with special multiple launcher with six rounds, erected on a submarine periscoping mast. Target acquisition is attained via periscope sighting and TV display and control. An intensive development of submarine acoustic sensors to provide a warning capacity against an approaching air threat has been undertaken by the US DARPA [71].

A defence system of the future is the US anti-ship missile defence programme (ASMD), undertaken in co-operation with FR Germany and possibly with other NATO countries, and projected to be a supplementary point-defence system to the existing Vulcan/Phalanx gun. Initially, the project includes development of a 5-inch (127-mm) ASMD missile based on the Sparrow RIM-7F airframe with Redeye/Stinger man-portable SAM IR terminal homing, Sidewinder AIM-9L fuze and warhead, and Chaparral/Sidewinder propulsion [42, 69]. In the same ASMD programme, 5-inch (127-mm) and 8-inch (203-mm) IR guided projectiles, an autonomous launcher (on ships where there is no Sparrow launcher), new radar, a new deceptive ECM module, and IR/RF decoys are included. The ASMD missile is planned to be operational before the newest US FCS—the Shipboard Intermediate Range Combat System (SIRCS)—will be fully developed. SIRCS is supposed to integrate fully all close-range defeces on a ship against any air or surface attacks [12b, 41f].

Naval guns and rocket systems

At the time when SSMs gave ships a very powerful offensive capability, it seemed that the role of naval guns—up to then the main sea weapon —was over. However, the threat posed by anti-ship missiles on the one hand, and the development of gun-launched PGMs on the other, provided fresh justification for the existence and further development of naval guns. Further supporting factors are: a missile may not be reliable in a dense ECM environment and in the presence of 'soft' anti-missile defences, such as chaffs, and IR and RF decoys; even the most advanced AA missiles have a longer reaction time compared with guns; guns are more economical and easier to service; even the best AA missile defence can be saturated, thus needing to be supported by other systems; and, finally, missiles are too costly and sophisticated to be expended on shore bombardment and assault support—the mission which is customarily reserved for guns and which can be better carried out with the help of their new munitions.

Naval guns have undergone substantial development, directed towards full automation of all their functions, increase of speed of fire, diminution of size and weight, and towards the provision of new, more lethal ammunition.

An excellent example of an increase in the rate of fire is provided by the French Catulle controlled-dispersion multiple rocket system now under study. This naval version of the Jevelot land-mobile weapon occupies a place between a missile and a gun. It has 64 tubes, each launching 40-mm projectiles with proximity fuzes (a remarkable achievement for such small calibre), autonomous sensors, designation and tracking systems, fire control and computation of all necessary data. A salvo from Catulle would be directed against low-flying aircraft or sea-skimming missiles. Another new idea pushed through the developmental stage by the French is the Rafale naval rocket system. The 147-mm rockets are launched in salvos of three (three-bank launcher, each with six rockets), and when each single rocket explodes at the appropriate time, it dispenses 35 grenades, each producing 160 high-velocity balls capable of penetrating 8-mm armour. A rocket burst of 5 600 balls (thus 16 800 in a three-rocket salvo), fired every second at incoming low-trajectory missiles, creates a dense barrage, difficult for a missile to overcome intact. The only other known on-deck multiple rocket-launching system is the 140-mm launcher on the Soviet 'Polnocny'-class landing ships [42].

There is an abundant variety of types of naval guns. Only some examples characterizing the present technical trends, such as NATO's Goalkeeper, the US CIWS Phalanx system, one alleged Soviet close-in gun, and some new single-barrel medium-calibre guns, will be discussed here.

The SEM 30 Goalkeeper—co-produced by the USA, FR Germany and the Netherlands—is a fully automatic, 4-barrelled, 30-mm gun, in some degree similar to the planned US Army DIVADS gun. It is supposed to intercept a target at a range of about 500 m. Since it cannot use proximity fuzes owing to smallness of round, it must destroy the target by a direct hit, which calls for high accuracy. Target detection, aiming and firing require no human intervention, all these functions being performed by search and doppler tracking radars, IFF device and closed circuit TV system. Together with a full load of ammunition, its mount weighs 5.5 t [72].

Another modern gun is the US CIWS Phalanx, representing the 'last-ditch' defence weapon against low-flying cruise missiles (although one source denies its anti-sea-skimmer capability [73]). It is also an automatic gun having an extremely fast reaction time and a controlled rate of fire, being able to fire up to 3 000 rounds of 20-mm calibre per minute, and creating an intense barrage in the way of an oncoming missile. More than 350 units of this system are planned for installation on over 200 US warships [41g, 69].

The only small-calibre rapid-fire gun in the Soviet Navy, presumed to serve as a point-defence gun, is the 23-mm, 6-barrel Gatling-type automatic gun on 'Kresta II'- and 'Kara'-class cruisers. Its rate of fire is given as 5 000 rounds per minute. There are, obviously, several other medium-calibre single-, twin-, and multi-barrelled AA guns on Soviet ships.

A completely new development in major calibre naval guns is the US MCLWGS. This 8-inch (203-mm) gun takes advantage of technological progress in other areas of military hardware. Thus it will utilize a semi-active laser guided projectile which is an outgrowth of the US Paveway programme (air-droppable guided munitions). The new gun replacing a 5-inch (127-mm)/54 Mk.45 gun can deliver double the amount of HE as the replaced one. The MCLWGS mount is only one-third as heavy as the similar calibre guns of World War II. The new type of laser-guided ammunition brings about 60 times better accuracy in comparison with ballistic ammunition. With such accuracy, the expenditure of ammunition may be kept to a minimum. This medium-calibre projectile will be capable of flying extended ranges when it is equipped with a rocket motor, and will provide ships with stand-off ranges of fire comparable to those possessed by the huge 16-inch (406-mm) guns of World War II battleships. Laser illumination of a target will be executed from the firing ship or from a mini-RPV. The new system will meet the requirement of the US Marine Corps for naval fire-support before their own artillery can be brought ashore [52c, 74].

Because of the growing vulnerability of modern FCSs to ECMs, there is a growing tendency to use optical systems as standard equipment for directing the fire of point-defence systems. The most modern of these electro-optical devices, such as the Bofors optronic fire-control instrument (BOFI) or the US SEAFIRE system, incorporate day and night sighting, light amplifier, and laser-rangefinder in one package. The BOFI system is attached to a gun, whereas SEAFIRE can be carried on a helicopter, in this way extending the fire control and targeting capabilities of naval guns over the horizon [7, 75, 76].

Torpedoes

Torpedoes are no longer the sole weapons on submarines. Guided missiles, of far greater range and superior speed, like the US Harpoon, are now taking over as main anti-surface ship weapons. However, torpedoes still remain the main means for attacking submarines. Owing to their low procurement costs and their large warheads, they still find use in anti-ship warfare. Torpedoes can be launched from all available platforms: submarines, surface ships, helicopters and aircraft. Modern torpedoes tend to be light and fast, and capable of diving deeper, functioning in shallow waters, attaining great distances, and resisting ECMs.

The traditional propulsion of torpedoes is by electric battery or steam engine. They are guided by wire or are free-running with pre-set depth and course angles. They are often active or passive acoustic homing, driven by liquid or solid fuel motors (e.g., Mk.46, the first to have such propulsion). Their weight differs, depending on the type of platform from which they are launched. For example, the British air-droppable MW30/Mk.44 weighs 233 kg, being rather typical for that mode of launch, whereas the ship- or submarine-launched British Tigerfish and the US Mk.48 mod. 1 weigh over 1 500 kg. Torpedo warheads have a conventional charge, with the exception of the Mk.45 Astor, where the warhead is nuclear. Warhead explosion is initiated either by an impact fuze, or by acoustic (French L4, British Tigerfish) or magnetic (French E 15) proximity fuzes. The homing heads of newer torpedoes and their on-board computers are connected with the submarine FCSs, as in the case of the West German SST4 or British Tigerfish.

In practice, nothing is known about Soviet torpedoes. They appear to be uniform—all of 21-inch calibre—with some alternatives possibly available for surface ships. It is known that several Soviet aircraft and helicopters carry torpedoes.

The technologically most advanced torpedo is said to be the US Mk.48, introduced into service in 1972. It is a primary weapon of the new US SSN-688 submarine. By 1981 the US Navy will deploy over 3 000 of these torpedoes. The Mk.48 reaches the extremely high speed of 55 knots (well over 90 km/h). It can run as far as 46 km, being wire-guided up to the point where its acoustic homing system locates the target. The detection range can be increased (in Mk.48 mod. 3) by signals from other sonars relayed through a two-way telecommunication link. With such ranges of detection and attack, the Mk.48 has an OTH capability. Moreover, it can dive down to about 900 m. In case of a miss it is programmed for multiple re-attack [77, 78].

Another US-produced torpedo-mine of special ASW role is the Captor, or encapsulated torpedo, which is a Mk.46 mod.4 torpedo inserted in mine-casing allowing long-term storage in deep water. Captor has a sophisticated acoustic detection system and a mini-computer which activates the torpedo-launching mechanism after an enemy submarine is discovered and identified in its vicinity. In this way it can lie on the ocean bottom, waiting for the target over a long period of time. This makes it an excellent weapon for sealing off narrow straits, thus creating an anti-submarine barrier. Apart from Captor, a number of similar programmes useful in ASW operations have been undertaken in the USA [42, 79]. See chapter 8, section II.

A new generation of torpedoes is under research in several countries —in the UK, Project 7511; in FR Germany, the SUT 21-inch (533-mm) torpedo; and in the USA, the Mk.48 Advanced Capabilities Program. This US programme will create the basis for two new solutions. One, called the Near Term Improvement Program (Neartip) was in 1978 to have produced a new version of the Mk.46 torpedo, the only one now deployed on both surface- and air-platforms. The other will bring about a Mk. XX ALTWT (advanced lightweight torpedo), derived from the Mk.48 [42, 80].

Other ASW weapons

A classic ASW weapon is the depth-charge thrown into the water from surface ships. The depth-charge has been developed into a weapon of large yield and substantial range, the latter being attained by attachment to rocket boosters as transporting vehicles. Medium-range rocket launchers for ASW charges, such as the Swedish Bofors 4-barrelled rocket launcher and the Soviet MBU 2500 and 4500, were developed in the late 1950s and early 1960s. Their range was approximately 1.8 to over 5 km. Another category of such weapons appeared in 1960 with the deployment of the ASROC long-range (8 km) ASW weapon, which is launched in a ballistic trajectory, carrying either a non-nuclear Mk.46 homing torpedo or a nuclear depth-charge. A similar stand-off anti-submarine weapon, operational in 1964, is the SUBROC submarine-launched missile, carrying a nuclear depth-bomb. SUBROC ignites under water, is then propelled out over the surface, flies to the target area, drops back into the water, and then homes on the target. Although dated, this weapon is proposed to be modified so that its usefulness will be extended into the 1990s, with the probability of being replaced by a new design of the Harpoon missile [81].

Other long-range and surface-launched anti-submarine missiles are the Anglo-Australian Ikara (20-km range), the French Malafon (13-km range), the Soviet SUW-1/FRAS-1 weapon similar to ASROC (about 25-km range), and also the Soviet SSN-14 rocket resembling Ikara (of 30-km range). Only the SSN-14 and probably the FRAS-1 are nuclear [72]. All but FRAS-1 are guided missiles and carry an acoustically homing torpedo dropped by parachute over the target area. Another Soviet ASW weapon, submarine-launched like the SUBROC missile, is the nuclear-armed SSN-15, with a presumed range of 40 km [78].

Technological advance as a mainstream of the naval arms race

Developments in naval weapon systems—some of which have been mentioned above—provide a good example of the evolutionary character of the present qualitative arms race. New types of naval weapons do not differ much in their external characteristics from their predecessors. Where they do differ is in the greater efficiency of action of their elementary components: more energy-rich composition of fuel; greater engine efficiency; higher accuracy of guidance packages; greater resistance to electronic, optical and other countermeasures; greater adaptability to various firing platforms; and smaller size and lower weight. In addition to these features of weapons per se, several technological improvements have taken place in entire weapon systems, in which the weapons are only links in a whole chain—from remote surveillance, discovery and location of a target, through quick and accurate delivery of the weapon in order to execute the attack and destruction of the target, to the assessment of the post-attack damage, and possible re-attack. The effective integration of all these stages and their technical perfection is undertaken by all the parties concerned, with the highly industrialized countries setting the pace. The technological improvements are based on a wide military R&D basis. Though costly, military R&D allows great economies to be made by decreasing the numbers of weapons without any corresponding loss in their efficiency. Savings made in this way are, however, of short duration. Once a weapon has been procured, efforts begin to look for a counter-weapon. Moreover, once a state obtains possession of the weapon in question, other states feel obliged to follow suit, thus starting the numbers game. As a result, countries end up with comparable arsenals of highly sophisticated—and hence costly—weapons. Thus, the US tenet of matching quantity with quality yields only a short-term advantage [82].

It is a dubious and even dangerous policy to believe, according to the following line of reasoning, that a dominant position can be attained by pursuing intensive technological programmes: "Recognizing that modern technology offers us and our allies the opportunity to dominate the oceans without necessarily building vast fleets of ships is the key to making favorable changes in our naval forces" [83]. Naval balances seem to be based on far too many components for any side to be able to achieve clear superiority across the board in all technological aspects of naval warfare.

The new or modernized naval weapon systems described above lead to a widening of the range of naval operations, which would soon envelope the globe in a network of military satellite systems and widespread platforms armed with very long range anti-ship missiles. The growing accuracy of naval weapons and their increasing speeds of attack introduce 'single-shot kill probability' considerations into predominantly tactical naval operations, urging the respective sides to look quickly for possible countermeasures and costly defences. One of the results of the entry of long-range SSMs and ASMs into the inventories of several navies is their growing potential utility in the power projection from sea to land (so far reserved to naval guns and aircraft).

This aspect of naval force is further strengthened by the development of the new laser-guided artillery rounds and the modern, fast and powerful amphibious forces.

III. The 'central' naval balance

The aim of this section is to ascertain the general situation between the naval forces of the North Atlantic Treaty Organization (NATO) and the Warsaw Treaty Organization (WTO) states. Such an undertaking is hemmed in by several obvious restrictions: any 'on-paper' balance of naval forces is dependent on the tactical situation they are going to be used in, varies with the geographical subregion considered, and is influenced by the accuracy of the sources on actual numbers of ships and their capabilities. In addition, there exist a disturbing variety of classifications of warships, changing with time and country. Finally, any sound comparison of forces must take into account the doctrines, tactics and motivations according to which the forces will be deployed and used. Here, different war scenarios will not be considered and geographical configurations will not be discussed in detail. Literature sources are often contradictory, and it is not intended to carry out an in-depth analysis of naval doctrines. Therefore, the following comparisons of forces and their capabilities will no doubt be subject to a substantial margin of error. The reader should therefore not expect a searching enquiry into military problems in relation to naval balances. The issues are approached from a political angle, in an effort to counter some biased propagandist viewpoints. Thus, numerical comparisons are made in the same categories of naval forces, instead of pitting naval forces against their likely counterforces and analysing their interrelationships in a specific geographical and operational setting, which would be more in accord with reality. However, despite these shortcomings, this simplified assessment of the naval balance ought to help in clearing up various questions connected with, and the main trends in, the present naval arms race. The clarification of various naval issues is important, since in recent years they have attracted public attention, and sometimes been presented in a biased or inaccurate way in order to win support for increased production and procurement of naval vessels.

Some basic comments

The two sides of the central naval balance operate in vastly different geographical settings. Western states have easy access to all but Indian Ocean waters. This greater accessibility has also increased the dependence of the USA and NATO on their sea communication and supply lines [1b]. The Soviet Union and its allies operate from widely separated ocean areas exposed to easy air, surface and underwater observation and blockade. Most of the Soviet ports with the exception of the Pacific port of Petropavlovsk on Kamchatka and Murmansk on the Kola peninsula have poor access to the open sea. Murmansk, though an open-sea port, is surrounded on the north and the east by permanent ice-barriers, which restrict the movement of surface ships. Petropavlovsk is shut in by ice for large periods of the year. These fleet areas cannot be quickly reinforced by warships from other areas. The Soviet naval aircraft are forced to overfly enemy or neutral territories, or to go on circuitous routes to get into distant patrol or combat areas, especially in the Atlantic.

Another point of basic importance is the difference in the historical development of Western and Soviet naval forces. As US Admiral S. Turner says, the Soviet Union has built up a navy "reacting to its perception of a threat from our once-overwhelming armed superiority at sea . . . " [84a]. After World War II, during which the Western allies of the Soviet Union demonstrated great capability for projecting and sustaining large armies on land, the shores of the Soviet Union lay totally exposed [85a]. The Western naval forces have shown their superiority at sea both in war and in conflict, in Korea and Taiwan, and later in Lebanon, Cuba and Viet Nam—to name only a few examples from a long list [86, 87a].

Even after substantially reducing their naval inventories in the 1950s and 1960s, the Western navies remained predominant. Moreover, they continued to retain a great capability for projecting sea-borne air and marine forces on land. With its industrial and technological base slowly expanding after World War II, the Soviet Union looked for a short-cut in matching the threat. This was done by developing the cruise missile, which could threaten even the largest warships from long distances. In view of the small number of Soviet surface ships and their complete lack of air-cover, these guided missiles were chiefly placed on aircraft and submarines.

Another important post-World War II naval development was the deployment in the early 1960s of the first US strategic SSBNs. The Soviet Union deployed its sea-based strategic deterrent forces some five to six years later. Since the gravest threat to a nuclear-powered submarine is another nuclear-powered submarine ('hunter–killer' submarine), both sides began to devote great attention to anti-submarine warfare [84b]. The aim was to protect one's own and to threaten the other's SSBNs and SSNs. Strategic ASW efforts were developed especially in the USA. Superior technology provided the

USA with effective means of acoustic surveillance. Moreover, the geographic configuration made Soviet submarines more readily susceptible to detection, which gave a bonus to US ASW activities [1b]. On the other hand, the heavy reliance placed by the Soviet Union on the submarine-launched anti-ship missile makes tactical ASW a vital issue for that country. ASW efforts still continue on both sides, giving rise to a growing number of ASW subsurface, surface and air platforms and giving an impetus to the development of sophisticated ASW sensors and weapons (see also chapter 8). However, because of the growing multifunctional character of modern ships, it is very difficult now to distinguish between their ASW and other roles. The systematically growing fire-power of primarily ASW-oriented ships—a feature observed especially in the Soviet Navy—permits the use of these ships in other roles. Thus, starting from purely coastal naval defences, the Soviet Navy was gradually able to deploy its forces in the Norwegian and North Seas and in the East China Sea and the western Pacific, and later on to contest the West's maritime dominance elsewhere [85b]—by sailing in 1968 into the Indian Ocean, in 1969 to the Caribbean Sea (notwithstanding the 1962 Cuban crisis), and in 1970 into West African waters [88]. Thus, the Soviet Union has achieved a sea-based strategic deterrence equal to that of the West; and a general naval presence to some extent comparable to the Western one. The overwhelming naval lead of the US alone, not to mention other NATO naval forces, in the years up to the early 1970s has been greatly reduced by now. However dismaying this realization may be for NATO and the USA, this narrowing of the margin of superiority is by no means a complete eradication of the Western naval predominance.

Static numerical balances based on sheer numbers of warships do not properly reflect the asymmetrical development of the respective navies and their different capabilities. A more meaningful way of examining the balance would be to observe changes in numbers (in general and in the specific classes of different warships); to note technological developments and the increasing vulnerability or potency of naval forces; and to analyse changes in the availability of base facilities, replenishment capacities, national political postures, and alliance capabilities [84b]. However, since such an in-depth analysis is not intended here, only the general quantitative and qualitative indicators of naval capabilities—of political rather than strictly military significance—will be considered.

Quantitative comparisons and trends in warships and naval aircraft

Comparing sheer numbers of ships is the least satisfactory—but the

Table 6.1. Surface naval strength of WTO countries, 1978

	USSR	Bulgaria	German DR	Poland	Romania	**Total WTO**
ASW (SSM) carriers	2					**2**
ASW helicopter cruisers	2					**2**
SSM cruisers	23					**23**
SAM/gun cruisers	13					**13**
Total cruisers	*38*					**38**
SSM destroyers	39					**39**
SAM/gun destroyers	71			1		**72**
Total destroyers	*110*			1		**111**
SSM frigates	–					–
SAM/gun frigates	41	2	1	–		**44**
Total frigates	*41*	*2*	*1*	–		**44**
SSM major combatants	64	–	–	–		**64**
SAM/gun major combatants	127	2	1	1		**131**
Total major combatants	*191*	*2*	*1*	*1*		**195**
SSM corvettes	17	–	–	–		**17**
Gun corvettes	180	–	–	–		**180**
Total corvettes	*197*	–	–	–		**197**
SSM FPBs	123	5	15	12	5	**160**
Gun/torpedo FPBs	252	8	70	21	21	**372**
Total FPBs	*375*	*13*	*85*	*33*	*26*	**532**
Total warships	**763**	**15**	**86**	**34**	**26**	**924**

Sources: References [14, 73, 93].

most frequently used—method of finding the real balance of naval forces [9c, 89]. The numerical strengths of navies composing the 'central' balance are given in tables 6.1 and 6.2. These tables take into consideration not only the numbers of ships possessed by the USA and the USSR, but also the total numbers of warships possessed by the respective alliances. West European fleets (France included) represent nearly 55 per cent of all NATO's major surface ships (frigates and above), with different shares in various classes of ships. Thus, omitting this force, as is often done, in the 'central' balance is a distortion of reality. On the other hand, the capabilities of the East European members of the WTO, as far as the major naval combatants are concerned, are very small. In the case of the United States and the Soviet Union all their forces are taken into account in tables 6.1 and 6.2, although large parts of these forces are deployed in the Pacific and Indian Oceans. In the Pacific, the Soviet Navy might also be confronted by the navies of other US allies, such as Japan and South Korea. Tables 6.1 and 6.2, showing the numbers of surface ships, indicate that in all categories of major combatants—including those armed with SSMs—NATO forces, together with France, enjoy a great numerical advantage over WTO naval forces. This superiority is greatest in the category of aircraft and helicopter carriers (31 to 2) and in the category of frigates

Table 6.2. Surface naval strength of NATO countries (including France), 1978

	USA	Belgium	Canada	Denmark	FR Germany	Greece	Italy	Netherlands	Norway	Portugal	Turkey	UK	France	Total NATO + France
Aircraft-carriers, nuclear	3													3
Aircraft carriers, conventional	12											1	2	15
Helicopter carriers	10											–	–	10
ASW carriers	4											–	–	4
Total aircraft-carriers	**29**											**1**	**2**	**32**
ASW helicopter cruisers	–						1					2	1	4
SSM cruisers, nuclear	7						–					–	–	7
SSM cruisers, conventional	22						2					8	1	34
SAM/gun cruisers	5						–					–	–	5
Total cruisers	**35**						**3**					**10**	**2**	**50**
SSM destroyers	39				7	1	4	2				5	12	70
SAM/gun destroyers	54		4		4	11	3	9			12	–	8	105
Total destroyers	**93**		**4**		**11**	**12**	**7**	**11**			**12**	**5**	**20**	**175**
SSM frigates	7	4	–	5	–	–	4	2	5		–	17	18	62
SAM/gun frigates	58	–	19	5	6	4	10	5	–	17	2	39	11	166
Total frigates	**65**	**4**	**19**	**10**	**6**	**4**	**14**	**7**	**5**	**17**	**2**	**56**	**29**	**228**
SSM major combatants	76	4	–	5	7	1	10	4	5	–	–	30	31	173
SAM/gun major combatants	146	–	23	5	10	15	14	14	–	7	14	42	22	312
Total major combatants	**222**	**4**	**23**	**10**	**17**	**16**	**24**	**18**	**5**	**7**	**14**	**72**	**53**	**485**
SSM corvettes	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gun corvettes	–	–	–	3	5	–	9	6	2	10	–	–	–	35
Total corvettes	**–**	**–**	**–**	**3**	**5**	**–**	**9**	**6**	**2**	**10**	**–**	**–**	**–**	**35**
SSM FPBs	1	–	–	10	30	12	1	–	27	–	7	–	5	93
Gun/torpedo FPBs	2	–	1	6	10	19	9	–	19	–	13	–	–	79
Total FPBs	**3**	**–**	**1**	**16**	**40**	**31**	**10**	**–**	**46**	**–**	**20**	**–**	**5**	**172**
Total warships	**225**	**4**	**24**	**29**	**62**	**47**	**43**	**24**	**53**	**17**	**34**	**72**	**58**	**692**

Sources: See sources to table 6.1.

(228 to 43). The actual proportions by category of ship are: in aircraft carriers 16 : 1, in cruisers 1.4 : 1, in destroyers 1.6 : 1, and in frigates 5.2 : 1. For all major combatants, the ratio is 2.5 : 1., and is widening even further in favour of NATO in the category of SSM-armed ships, being 2.7 : 1. The only category in which WTO naval forces possess numerical superiority is the category of light naval forces (corvettes and FPBs). These vessels are suitable for powerful operations in coastal and closed-sea waters but are of no or only marginal utility in open-sea operations. Mine warfare forces are not taken into consideration here; the WTO is believed to be preponderant in this category of ships. All aforementioned proportions would differ in various regional waters, especially in the Mediterranean and North Seas, where NATO preponderance is still more distinct. To a large degree, the proportions of ship inventories correspond to the length of coastlines and to the dependence of some states on their sea-lines of communication and supply.

One of the more controversial figures in table 6.2 is the number of US helicopter carriers. This figure represents all US amphibious assault ships of LHA- and LPH-class, of large displacement (3 'Tarawa'-class of 39 300-ton and 7 'Iwo Jima'-class of 17 000-ton displacement), able to carry from 30 to 24 helicopters respectively and said to be able to operate V/STOL aircraft. (The same ships are also included in table 6.7, on amphibious forces).

The numbers of warships in both alliances have been gradually declining over the past decade [32b, 90], however, with a concomitant transition from old gun-armed ships to modern missile-armed ones [88b, 91]. On the Soviet side, the fastest growing categories are helicopter carriers (5 expected by 1982) and guided-missile cruisers. The new production of other classes is offset by the need to replace older ships [92]. NATO forces, especially the US and British navies, cut their inventories nearly by half during the first two decades after World War II. This reduction has been the main factor behind the relative decline of numerical strengths of NATO navies in comparison with the Soviet one. This process of reduction came to a stop in the early and mid-1970s and has now been reversed. NATO plans include: in the US Navy to build some 30 improved 'Spruance'-class guided-missile destroyers and some 50 new SSM FFG-7 frigates [6b]; in the British Navy three new anti-submarine helicopter cruisers are to be constructed; the *Bundesmarine* to acquire up to 12 F.122 frigates; Italy to get one helicopter cruiser and six frigates of 'Maestre'-class; the Netherlands to procure 11 'Kortenaer'-class SSM frigates; and France to go ahead with its 'Blue Plan' for substantial modernization of the entire navy, in part by including a new nuclear-powered aircraft-carrier and over 20 destroyers. Similarly, an extensive expansion is planned by several NATO states in their light naval forces [93].

General numerical comparisons alone say little about military effectiveness, since this also depends on the actual concentration and configuration of warships in a given sea-area, on the timing of an engagement, and on several other technological and organizational conditions. For example, a small number of dispersed ships can threaten important lines of communication and supplies or may carry out a successful operation against a potentially stronger navy. All such gains are, however, only tactical or temporary; in a protracted naval war, the more numerous navy would take over, especially if technologically equal or superior.

A different and more professional method of naval comparisons was used in *The Military Balance, 1978–79*, published by IISS. Here, comparison was based on the mission to be fulfilled by a specific task group of warships (though the Soviet Navy would not, most probably, operate in any 'task group', in the Western sense of the term). According to this publication, NATO forces—especially the so-called sea-control forces—are "considerably greater by any assessment than their Soviet counterparts" [9d].

Table 6.3 gives numerical inventories of all types of submarine operated by the two alliances. Here the balance in numbers is tipped in favour of the WTO, which possesses some 100 submarines more than NATO. A particularly large difference in numbers is visible in the categories of diesel and nuclear submarines equipped with guided misssiles —72 to 2 in favour of the WTO—and in diesel ballistic missile submarines (obsolescent in view of modern ASW). A rough balance exists in smaller, conventionally powered patrol and attack submarines. The general trend on both sides is to replace older diesel submarines by new nuclear-propelled ones. A substantial number of the Soviet diesel patrol submarines are old-fashioned, being withdrawn from use quicker than the rate of replacement; thus, the overall number of Soviet submarines is declining. It is interesting that only a very small portion of the Soviet nuclear submarine fleet is out at sea. On a day-to-day basis, only 15 per cent of the Soviet SSBN force is out of port, in comparison with 55 per cent for the US SSBNs [94].

Naval forces include large numbers of aircraft and helicopters. More than 30 different types (several of them in a number of versions) of fixed-wing aircraft and about 20 types of helicopter are in use by the Eastern and Western blocs. Numerical balances between the NATO and WTO naval air-forces are summarized in table 6.4. The table shows that NATO naval air-power leads in practically every category of aircraft. This superiority is especially great in sea-based aircraft, giving NATO a

Table 6.3. Submarine inventories of NATO (including France) and WTO countries, 1978

	USA	Canada	Denmark	FR Germany	Greece	Italy	Netherlands	Norway	Portugal	Turkey	UK	France	**Total NATO + France**	USSR	Bulgaria	Poland	**Total WTO**
SSBN	41	–	–	–	–	–	–	–	–	–	4	4	**49**	72[a]	–	–	**72**
SSB	–	–	–	–	–	–	–	–	–	–	–	1	**1**	22	–	–	**22**
SSGN	–	–	–	–	–	–	–	–	–	–	–	–	**–**	46	–	–	**46**
SSG	1	–	–	–	–	–	–	–	–	–	–	–	**1**	26	–	–	**26**
SSN	70	–	–	–	–	–	–	–	–	–	10	–	**80**	41	–	–	**41**
SS	8	3	6	24	7	8	6	15	3	12	17	23	**132**	154	2	4	**160**
Total submarines	**120**	**3**	**6**	**24**	**7**	**8**	**6**	**15**	**3**	**12**	**31**	**28**	**263**	**361**	**2**	**4**	**367**

[a] Two of these submarines are not operational, and 8 of older design are not counted under the SALT I provisions.

Sources: See sources to table 6.1.

Table 6.4. Sea- and land-based naval aircraft in NATO and WTO countries, 1978

	USA	Belgium	Canada	Denmark	FR Germany	Greece	Italy	Nether-lands	Norway	Portugal	Turkey	UK	France	**Total NATO + France**	USSR	Bulgaria	German DR	Poland	Romania	**Total WTO**
Afloat aircraft:																				
Fixed-wing aircraft																				
Air combat	~ 750											32	40	**~ 822**	24					**24**
ASW	130											–	40	**170**	–					–
Total, all types[a]	**~1 100**											**37**	**80**	**~1 217**	**24**					**24**
Helicopters[b]																				
ASW	~ 200		16	5			~30	9				~ 90	~ 20	**~ 370**	101					**101**
Other types[c]	~ 320		9	–			–	–				~ 55	~ 20	**~ 404**	–					–
Total helicopters	**~ 520**		**25**	**5**			**~30**	**9**				**~145**	**~ 40**	**~ 774**	**101**					**101**
Ashore aircraft:																				
Fixed-wing aircraft																				
Long-range[d] recce/ASW[e]	~ 450[f]		26	–	19		18	8		6		35	35	**~ 597**	135[i]					**135**
Long-range attack[g]	–[h]		–	–	–		–	–		–		–	–	**–**	50[j]					**50**
Medium-range recce/ASW	–		30	–	–	8	8	15	5	–	22	11	20	**119**	150[k]					**150**
Medium-range attack	–			–	–	–	–	–	–	–	–	14	24	**38**	~300					**~300**
Air combat[l]	–		–	–	112	–	–	–	–	–	–	14	20	**~ 145**	60			60		**120**
Total, all types[a]	**~ 450**[m]		**65**	–	**154**	**8**	**26**	**23**	**5**	**6**	**22**	**86**	**~200**	**~1 045**	**695**[n]			**60**		**755**
Helicopters																				
ASW	–	8	32	15	–	4	~50	36	10	–	9	~ 80	60	**~ 304**	~200	6	13	25	4	**248**
Other types	–	–	–	–	21	–	~20	–	–	–	–	~100	–	**~ 141**	–	–	–	–	–	–
Total helicopters	–	**8**	32	15	21	4	~70	36	**10**	–	9	~180	60	**~ 445**	~200	6	13	25	4	248

[a] Includes also tankers, AEW, and EW aircraft.
[b] Helicopters on all naval ships, including amphibious helicopter assault.
[c] Includes commando assault, command, utility, etc.
[d] 'Long-range' meaning about 2 500 nautical miles (4 000 km) range or more.
[e] Including maritime patrol and in some cases AEW aircraft.
[f] This figure does not include 10 EC-121 AEW aircraft having maritime role, removed from active service; ~200 Orion P-3Cs in reserve being included in the figure.
[g] 'Attack' meaning anti-ship capability (ASMs, bombs, torpedoes); 'air combat' planes with such capability not taken into account.
[h] 75 B-52Ds may be used in this role.
[i] 4 Tu-95 Bears of Long Range Aviation not included, although may have naval utility.
[j] 100 Tu-95 Bears of Long Range Aviation not included, although may have naval utility.
[k] 115 Tu-16 Badgers of Long Range Aviation, used for ELINT and reconnaissance not included.
[l] These are exclusively used for naval missions.
[m] 117 C-130 Hercules transport and tankers not included.
[n] 230 transports and tankers not included.

Sources: References [6, 9, 14, 95, 111, 112, 113, 114, 115].

complete air command over the NATO operation areas as well as providing it with a powerful means of attacking land targets from the sea. The sea-based NATO aircraft are to some extent matched in number by the Soviet land-based long- and medium-range bombers, carrying various anti-ship weapons. The biggest role in this connection can be played by the Tu-26 Backfire, here considered as a long-range attack aircraft—the only supersonic Soviet naval aircraft. This aircraft, being introduced into the inventory at a rate of some 12 per year, is gradually replacing other ageing Soviet long- and medium-range maritime bombers. Although the Soviet bombers armed with long-range ASMs constitute a powerful force, they have to operate from very distant bases; and when flying to open-sea stations, they are exposed to strict surveillance and would be attacked by NATO's land air-forces in war (first Norwegian, and later British, US and other forces). No land-based Soviet fighters have the range required for escorting bombers to their distant station areas [95]. Western AEW capabilities are extensive and numerous, now being updated with the new Orion (EP-3E) and AWACS aircraft entering service. Although NATO does not deploy any naval long-range anti-ship aircraft, there are a large number (75) of US SAC B-52D aircraft technically prepared and trained for maritime operations, such as mine-laying, sea-surveillance, and possibly bombing of surface vessels. The NATO maritime reconnaissance and ASW air forces are twice as large as their WTO counterparts. In helicopter inventories the picture is similar as far as forces afloat are considered, NATO possessing substantially more of them. A more balanced situation exists in land-based helicopter forces. On the NATO side there is a greater reliance on helicopters for other than ASW duties, especially search and rescue and assault.

The figures given in table 6.4 are all approximations. As in any other comparisons here, the qualities of the weapon systems and their mode of operation may have a great influence on any conclusions on real balances. Also, land-based air forces, not generally considered for naval operations, may, in reality, be used in battle over the sea if their range permits it. These important factors are not considered further here.

Developments in naval air forces on either side indicate that increasing importance is being attached to naval air-power. The Soviet Union is enlarging its fleet of aircraft and helicopter carriers. The comparatively small size of carriers and the small number of aircraft they carry indicate that their chief role is in ASW and reconnaissance, and that they have a secondary role in providing air defence. Despite these constraints, the deployment of these vessels has, for the first time, provided Soviet ships with an organic air-defence in remote seas. On the

NATO side, nearly all member states are planning fast modernization and expansion of their naval air-arm. The USA is procuring large numbers of F-14 Tomcat fighters and is developing another air superiority F-18 fighter and V/STOL aircraft [96–98]. The US ASW capabilities will also be increased by the introduction of LAMPS III helicopters [17a, 62]. The UK plans to procure two or three through-deck cruisers, and has already ordered 35 Harrier V/STOL aircraft, 165 MRCA Tornado aircraft, and over 80 Sea King and Lynx helicopters. FR Germany plans to acquire 110 Tornado aircraft to replace its F-104Gs. Denmark, Norway and Turkey have ordered several Lynx helicopters, and France has ordered about 30 Super Etendard fighters and a number of Lynxes. These plans prove that NATO intends to enhance its indisputable naval air superiority.

Balance in ship-launched missiles

The guided missile is the main offensive weapon of today's ship. Thanks to the deployment of extremely able and compact FCSs, missiles, together with guns, play a major role in the defence against ASMs. In order to ascertain the balance in numbers and qualities of naval weapon systems possessed by the NATO and WTO states, all available weapons would have to be taken into account, including those on aircraft and submarines. This is, however, next to impossible, since both aircraft and submarines can carry mixes of weapons, depending on

Table 6.5. Numbers of WTO ship-to-ship (SSM) and ship-to-air (SAM) missiles on launchers, by type and country, 1978

Type of missile[a]	USSR	Bulgaria	German DR	Poland	Romania	Total WTO
SSMs						
SSN-1	4					4
SSN-2	572	20	48	48	20	708
SSN-3	345					345
SSN-7	140					140
SSN-9	114					114
SSN-12	16					16
Total SSMs	**1 191**	**20**	**48**	**48**	**20**	**1 327**
SAMs						
SAN-1	132	–	–	4	–	136
SAN-2	2	–	–	–	–	2
SAN-3	80	–	–	–	–	80
SAN-4	184	–	–	–	–	184
Total SAMs	**398**	–	–	**4**	–	**402**

[a] Anti-submarine missiles, such as SSN-14 (over 100 deployed) are not taken into account.

Sources: See sources to table 6.1.

Table 6.6. Number of NATO ship-to-ship (SSM) and ship-to-air (SAM) missiles on launchers, by type and country, 1978

Type of missile[a]	USA	Belgium	Canada	Denmark	FR Germany	Greece	Italy	Netherlands	Norway	Portugal	Turkey	UK	France	Total NATO + France
SSMs														
SS11	–	–	–	–	–	–	–	–	–	–	–	–	4	**4**
SS12	–	–	–	–	–	–	–	–	–	–	–	–	24	**24**
Exocet MM 38	–	16	–	–	136	32	–	–	–	12	–	84	78	**258**
Penguin	–	–	–	–	–	–	–	–	150	–	–	–	–	**150**
Otomat	–	–	–	–	–	–	34	–	–	–	–	–	–	**34**
Harpoon	n.a.[b]	–	–	88	12	–	–	32	–	–	64	–	–	**196**
Total SSMs	n.a.	**16**	**–**	**88**	**148**	**32**	**34**	**32**	**150**	**12**	**64**	**84**	**106**	**666**
SAMs														
Crotale	–	–	–	–	–	–	–	–	–	–	–	–	32	**32**
Masurca	–	–	–	–	–	–	–	–	–	–	–	–	6	**6**
Sea Cat[c]	–	–	–	–	–	–	–	48	–	–	–	444	–	**492**
Sea Dart[c]	–	–	–	–	–	–	–	–	–	–	–	12	–	**12**
Sea Slug[c]	–	–	–	–	–	–	–	–	–	–	–	14	–	**14**
Sea Sparrow[c]	540	32	48	40	–	8	32	24	–	–	–	–	–	**724**
Sea Wolf	–	–	–	12	–	–	–	–	–	–	–	12	–	**24**
Standard MR[c]	12	–	–	–	–	–	4	–	–		–	–	4	**20**
Standard ER[c]	60	–	–	–	–	–	–	–	–	–	–	–	–	**60**
Talos	10	–	–	–	–	–	–	–	–	–	–	–	–	**10**
Tartar[d]	56	–	–	–	3	–	–	2	–	–	–	–	–	**61**
Terrier[d]	26	–	–	–	–	–	6	–	–	–	–	–	–	**32**
Total SAMs	**704**	**32**	**48**	**52**	**3**	**8**	**42**	**74**	**–**	**–**	**–**	**482**	**42**	**1 487**

[a] Anti-submarine missiles (such as SUBROC and Malafon) are not taken into account.
[b] The exact number is not available, since they are installed in large numbers on several surface ships and submarines.
[c] SSM capability.
[d] Difficult to ascertain in many cases which of the two missiles is actually deployed on a given ship.

Sources: See sources to table 6.1.

mission. Thus, only SSMs and SAMs will be considered here. There are three possible ways of indicating the number of naval missiles: (*a*) number of launchers (from single, to twin, quadruple and octuple); (*b*) number of tubes or rails from which a missile is launched—in other words, number of missiles on launchers theoretically 'ready' for firing; and (*c*) number of missiles in magazines, or re-loads. The two latter seem to be more instructive than the first, and tables 6.5 and 6.6 give information on numbers of rails/tubes, equal to the number of missiles ready for fire. The quantity of missiles in ships' magazines is very difficult to obtain from open sources. It is, however, known that NATO ships are more spacious and carry larger amounts of re-loads than do Soviet ships. Also, the number of SAMs for re-load on warships is much greater than the number of SSMs. Thus, for example, the US cruisers of 'Leahy' class, fitted with two twin launchers for Standard ER missiles, have 80 re-loads, whereas the Providence cruiser has 120 re-loads of the Terrier missile for its single twin launcher, and the Oklahoma cruiser has 46 Talos re-loads for a similar launcher. The majority of US destroyers carry about 40 Standard ER missiles for re-loading. The Netherlands 'De Ruyter'-class destroyer has one complete Harpoon re-load for its single octuple launcher, 40 Tartar re-loads for one single launcher, and 60 Sea Sparrow missiles for re-loading a single octuple launcher. In comparison, the Soviet 'Moskva'-class helicopter cruiser, armed with four twin SAN-3 launchers, is said to carry 180 re-loads, whereas 'Kresta'-class cruisers, fitted with two twin SSN-3 launchers and one twin SAN-1 launcher, have no re-loads for the first type and an unknown number of re-loads for the second type of missile. A 'Kynda'-class cruiser, equipped with two quadruple SSN-3 launchers and one twin SAN-1 launcher, are supposed to carry only one SSN-3 re-load per tube and about 30 SAN-1 re-loads [14, 93].

Over a period extending from the 1960s to the early 1970s, the Soviet Union was considered to be superior in numbers and even in technical advances in anti-ship missiles. However, during the past decade, NATO countries have undertaken intensive programmes for developing several types of such missiles and deploying them in large numbers. The most recent to join this effort was the USA, but now, with the Harpoon SSM programme completed and with the Tomahawk cruise missile in development, that country plans rapid and extensive armament in anti-ship long-distance guided missiles.

The actual situation in the numerical deployment of SSMs and SAMs is shown in tables 6.5 and 6.6. WTO forces deploy over 600 SSMs more than NATO. However, nearly half of the total WTO numbers—that is, 610 missiles—are on FPBs. More than half of the total number of SSMs are short-range SSN-2 missiles. The number of SSN-3 missiles is made up of those carried by both surface ships (48) and by submarines (297). In addition to 1 327 SSMs possessed by the WTO, there are well over 300 ASMs on long-distance Soviet bombers and several hundred torpedoes on submarines, all of them representing a threat to surface ships.

NATO's inventory of SSMs on launchers, indicated in table 6.6, is half that of the WTO. However, the figures given in the table do not include those types of SAMs which also possess anti-ship capability, such as Sea Dart, Sea Cat, Sea Slug, Standard and some versions of Sea Sparrow missiles. The number of these SAMs with anti-ship capability is about 600–800. In addition a growing number of Harpoon missiles are now being installed on several US ships, submarines, and naval aircraft, partly in replacement for older types of missiles. Altogether, the SSM inventory on the NATO side is rapidly closing the gap with WTO SSM forces, especially after the deployment of air-launched anti-ship missiles, such as the West German Kormoran. The pace of arming the Western warships with SSMs is such that in the near future some 75 per cent of the NATO fleet will be thus equipped [99]. When US naval and air forces acquire the Tomahawk cruise missile, the balances in anti-ship missiles will undoubtedly be reversed, giving the numerical and technological advantage to NATO forces.

Both sides are deploying large quantities of anti-submarine missiles and rockets, such as ASROC, SUBROC and Malafon on the NATO side, and SSN-14 on the WTO side. These weapons have not been included in tables 6.5 and 6.6, although some, like SUBROC, have anti-surface-ship capability.

As far as SAMs are concerned, NATO forces, possessing nearly four times more such missiles on launchers, are much better prepared for defence against attacking SSMs and aircraft than WTO forces. This is a logical outcome of NATO's awareness of the early development of Soviet anti-ship capabilities.

In assessing the actual balance between the opposing weapon systems, numbers naturally play a secondary role. The effectiveness of a missile attack on ships depends on the ability to saturate the ship's defence in a massed and concentrated attack. Therefore, the problem of target acquisition, surveillance and warning, control and coordination, as well as communication, is of decisive importance for the outcome of any engagement. Some indication of the efficiency of an attack by anti-ship missiles is afforded by the historical experience of Japanese kamikaze attacks on US ships during World War II (disregarding the difference in guidance, speed and size between the Japanese aircraft and present-day guided missiles). According to such parallels, of 1 000 attacking missiles only 70 would reach a target (one of nine ships in the US carrier group) despite active defences, giving an average figure of 7.8 hits per ship [83b]. According to this figure and the numbers of SSMs possessed by either side of the 'central' balance, and taking into consideration the rapidly growing capabilities of ship defences, it is more and more dubious whether anti-ship missiles can still be called all-powerful weapons, although they have surely changed the character of naval warfare.

General qualitative comparisons

Behind any technological characteristics of a weapon system stand a great variety of basic technological and engineering advances. This general technological base is decisive in the creation of an effective weapon system. It is believed that the United States and European NATO countries are well ahead of the Soviet Union in such fields of science and technology as electronics, computers, integrated circuits, night vision optics, small turbofan engines, microtechnology, submarine noise suppression, and electronic warfare [67b, 100]. Less certain is Western superiority in composite materials, inertial instrumentation for guidance systems, and in satellite-based sensors. In the field of ship design for maximum fire-power, and probably in gas-turbine technology for ship propulsion, the Soviet Union is believed to be ahead [33b].

It has been said that the effectiveness of any weapon system depends as much on the characteristics of the weapon itself as on the whole chain of technical and organizational elements allowing this weapon to traverse long distances and accurately to hit the target. A missile flying over the horizon of a ship's radars must be able to recognize a target ship among several other ships in the given area. It must be resistant to ECMs, distinguish between decoys and target, and should be able to take evasive action against the target's defences. Hence, for the effective use of long-distance missiles, surveillance and targeting technologies and real-time relay of data are crucial. The existence of long-range guided missiles makes the side using them dependent on external targeting sensors, located on different platforms and all exposed to growing threats. In all these areas of military technology the Western states claim to be in a more advanced stage of readiness than the Soviet Union is believed to be.

It is sometimes presumed that the only chance for a successful Soviet attack with anti-ship missiles would lie in sending a large number of missiles at a group of ships in a short span of time [101]. However, such saturation-attack from several platforms placed at different distances from the target requires that the exact positions of both firing ships and targets be simultaneously known. Hence, the proficiency of C3 systems is a first priority. Some Western observers, on evidence from large WTO manoeuvres, such as the 'Okean' exercises, believe that Soviet warships have rather good communication with their command centres [102] but rather poor ability to communicate between themselves as far as combat data exchange is considered. However, this area of Soviet technical capability is a matter of guesswork. Thus, the previous statement about the good communication links of the Soviet Navy is questionable to some extent on the grounds of the frequent disturbances to which high and very high frequencies, used by Soviet ships, are exposed in time of solar activity, especially in the Northern regions. At the same time, there are indications that 'Kiev'-class ASW cruisers and 'Kara'-class cruisers may have a first generation of NTDS-like capability [67b]. The problems of communication between the command centre and individual ships could be alleviated by the development of a satellite network. This fact seems to be recognized by all states able to launch satellites and possessing large ocean-going fleets. However, this trend would make all the states concerned more and more satellite-dependent, offering a further justification for preparing for anti-satellite warfare (see chapter 4, section II).

Most of the Soviet anti-ship missiles are deployed on submarines. However, a single Soviet submarine has rather a limited number of them, from 3 to 10. To obtain the required saturation of attack, a large number of these vessels would have to approach rather close to the target. The exposure of the submarines to ASW sensors and weapons would then be certain. The combat suitability of cruise missiles depends on the scenario of their use; they can be considered dangerous in a salvo attack against a group of ships, but on the other hand, such a mass attack would be very unprofitable in a prolonged war at sea.

Several of the Soviet-produced missiles were designed some 10–20 years ago. They are large and have unsophisticated homing systems, as the naval engagements in the 1973 Middle East War showed. In comparison, the majority of NATO missiles have a capability for various modes of attack, from sea-skimming to under-keel and steep diving on the target. Thus, defence against them is more difficult. Moreover, their guidance and homing systems are designed to be highly resistant to ECMs. The importance of 'software', composed of radars and computers, is even more decisive in FCSs for air defences. The Western systems are said to have the capability for multiple target handling, probably unmatched by the present Soviet designs.

The Soviet Union is well advanced in ship designing. Soviet ships and submarines are very fast, rather small and heavily armed. These features given them good manoeuvrability, a small radar cross-section, and strong fire-power. On the other hand, the same features give rise to a number of deficiencies, such as noisiness of submarines, a greater danger of being sunk by smaller explosive yields when hit, a small re-load capacity for weapon launchers and difficulty in refitting with newer weapons. Thus, the survivability of these ships is believed to be rather small, and their utility in a protracted war limited. In comparison, the Western vessels are larger, carry fewer weapons, and in many instances are slower. However, in the age of supersonic missiles, speed is a less important factor. Since NATO warships are to operate in groups, they can reinforce each other in combat and thus increase their fire-power. Also, their modular design makes them easy for retrofitting, modernization and repair [87b].

Many authors writing about naval balances stress the preponderance of the Soviet fleet in its number of submarines. This statement should, however, be seen against the background of the existence of extensive and advanced anti-submarine capabilities of NATO navies and the geographic constraints under which the Soviet Navy has to operate [34c].

As US Navy Admiral T. B. Hayward states: "Air superiority is the *sine qua non* of successful surface ship operations in modern war . . . " [6c]. The figures given in table 6.4 prove that such a superiority is on the NATO side. With aircraft like the F-14 and F-18 armed with modern AAMs (e.g., Phoenix) coming into inventories in large numbers, this superiority will be further strengthened.

Mention must also be made of the replenishment capability of the navies under consideration. Soviet ships are said to have restricted endurance (nuclear submarines excluded). Moreover, they lack good refuelling gear, increasing the time required for underway replenishment. The Soviet Navy also lacks an extensive system of support bases and facilities in foreign countries. All these factors indicate a restricted capacity for sustained surface naval operations [34d, 87c].

The emerging picture of the naval balance between the NATO and WTO forces does not corroborate with the doomsday-like descriptions of the rapid decline of Western naval capabilities. It is more appropriate to say that an approximate equilibrium—to use an expression from the SALT lexicon—exists as far as the numbers of ships are concerned and when the reliance on, and importance of, the sea-lines of communication of the two alliances are taken into account. The numerical preponderance of NATO over the WTO in warships persists if amphibious ships are also taken into account, but vanishes if coastal defence ships are additionally included. A rough balance also exists in the offensive and defensive capabilities of ships, to the accompaniment of a steady expansion of NATO ASW, SSM and SAM capabilities. The total numbers of ships largely remain stable, since the more sophisticated and capable ships tend to be restrictively costly, smaller numbers thus being procured by either side for the same amount of money. Therefore, the mainstream of the contemporary naval arms race is the technical sophistication of ships and their weapon suites, with a strong reliance on the software side of weapon technology.

Balance in amphibious forces

Amphibious forces constitute a highly mobile, powerful and flexible armed service, effective in military action or in political coercion in a crisis situation. They are especially useful in the case when a country considers it vital to deploy its armed strength in any crisis involving its interests. This sort of 'crisis management' is especially in line with US doctrine, as is indicated by the pronouncements of prominent US officers [2b] and by the strength of the US marine forces. Amphibious operations are nothing new, but, for example, today's well-armed and heavy-lift helicopters and hovercraft permit an assault to be made with a speed of over 20 knots, that is, twice as fast as in the Second World War. The emerging PGMs (such as semi-active laser-guided projectiles) and helicopter 'gunships', provide obvious advantages in the projection of forces ashore, especially against an unprepared or less modern defence [103a].

Amphibious forces are being improved in both NATO and the WTO. The role played in this respect by air-cushion vehicles has been discussed earlier. In 1978 the Soviet Navy launched a new large landing ship of 14 000-ton displacement, the first with a capability for long-range naval operations, able to carry a force of one naval infantry battalion and two helicopters. This ship is more than three times as large as any other landing ship in the Soviet Navy.

Nothing, however, may be compared with the strength and rate of growth of the US amphibious fleet. In addition to over 65 large landing ships, the United States is on the way to procuring five ships of the 'Tarawa'-class (as described above).

The strengths of NATO and WTO amphibious forces—both ships and manpower—are shown in table 6.7. The figures indicated here prove that there exists a strong numerical superiority of NATO amphibious forces over the WTO. The latter's forces are mainly composed of small landing craft, useful only in close-water operations along the shore-lines close to the borders of WTO countries. On the NATO side, the bulk of amphibious forces belongs to the USA, supporting the point that this country is the only one able to carry out mass amphibious operations around the world. Such a capability is all the more desirable to the USA since its reliance on overseas bases is shrinking all the time.

Table 6.7. Amphibious forces, NATO and WTO countries, 1978

	Approximate full load displacement (tons)	USA	FR Germany	Greece	Italy	Netherlands	Norway	Portugal	Turkey	UK	France	**Total NATO + France**
Ships and landing craft												
Helicopter commando cruiser	12 000–20 000	–	–	–	–	–	–	–	–	2	1	**3**
Amphibious command ship (LCC)	19 000	2	–	–	–	–	–	–	–	–	–	**2**
Amphibious assault helicopter ship (LHA, LPH)	18 000–40 000	10	–	–	–	–	–	–	–	–	–	**10**
Landing dock, cargo, transport (LPD, LPA, LKA)	10 000–20 000	36	–	1	–	–	–	–	–	2	–	**39**
Landing ship	8 000	23	–	–	2	–	–	–	–	–	2	**27**
Landing ship	4 000– 6 000	–	–	10	–	–	–	–	2	7	5	**24**
Landing ship	1 000– 2 000	–	–	5	–	–	–	–	–	2	2	**9**
Landing ship	300– 1 000	–	20	6	19	7	–	1	35	3	11	**102**
Landing craft	20– 200	108	28	47	61	–	12	9	43	82	36	**426**
Specialized marine forces		192 000	–	2 000	1 700	2 000	–	–	–	7 750	4 500	**208 950**

		USSR	Bulgaria	German DR	Poland	Romania	**Total WTO**
Ships and landing craft							
Helicopter commando cruiser	12 000–20 000	–	–	–	–	–	–
Amphibious command ship (LCC)	19 000	–	–	–	–	–	–
Amphibious assault helicopter ship (LHA, LPH)	18 000–40 000	–	–	–	–	–	–
Landing dock, cargo, transport (LPD, LPA, LKA)	10 000–20 000	–	–	–	–	–	–
Landing ship	8 000	–	–	–	–	–	–
Landing ship	4 000– 6 000	20	–	–	–	–	**20**
Landing ship	1 000– 2 000	74	–	4	23	–	**101**
Landing ship	300– 1 000	99	18	8	–	–	**125**
Landing craft	20– 200	135	–	12	15	42	**174**
Specialized marine forces		14 500	–	2 100	7 000	–	**23 600**

Sources: References [9, 14, 93, 103].

IV. Expansion of light naval forces

The term 'light naval forces' as it is used here comprises several different vessels: corvettes, coastal escorts, gunboats, large and coastal patrol craft (PC), coast guard and maritime safety agencies' armed vessels, and last but not least, all types of FPB. The common denominator of this class is a displacement of less than 1 000 tons and close-to-shore operation. From the purely military point of view, these vessels represent different types of weapon systems of largely varying capabilities—from missile and torpedo FPBs to slow gun- or machine-gun-armed patrol boats. However, being so different, all of them can be used equally well in quasi-military or police-like patrols, or in purely military duties on vastly different operational scales.

Available figures clearly show that in the last decade there has occurred a steep rise in the numerical and qualitative characteristics of the world-wide light naval forces. In order to understand this trend, various factors have to be taken into account: the country or region concerned, the incentives behind the acquisition of specific vessels at a given time, the economic interests involved in buying or selling, and the military interests. These factors are discussed below (see also tables 6.8, 6.9 and 6.10).

1. Since the early 1960s, the number of states has grown steadily with the decolonization process. Many of these states have long coastlines, usually unprotected by naval forces. It is therefore natural, although costly, for these states to acquire such forces. Expansion of these forces

Table 6.8. Numerical strength of the light naval forces in 1975, 1978, and 1978 including outstanding orders, by region and by type of vessel

	PC (excl. FPBs)			FPBs (all types)			FPBs (missile-armed only)		
Region	1975	1978	1978+	1975	1978	1978+	1975	1978	1978+
Europe, USA and Canada	678	742	751	649	804	868	173	278	332
North Africa	41	54	60	20	44	63	12	25	40
Other Africa	118	142	142	46	75	83	19	32	40
Middle East	166	324	342	114	158	184	44	82	108
South Asia	17	34	36	29	42	46	8	16	16
Far East Asia	577	657	748	873	1 112	1 139	119	223	241
Central America	140	183	186	47	60	62	23	26	26
South America	144	166	168	14	20	38	–	6	8
Oceania	18	27	42	–	–	–	–	–	–
World total	**1 899**	**2 329**	**2 475**	**1 792**	**2 315**	**2 483**	**398**	**688**	**811**

Sources: References [9, 14, 93, 116].

Table 6.9. World-wide numerical strengths of light naval forces in 1975, 1978, and 1978 including outstanding orders, by type of vessel

Type of vessel	Region	1975	1978	1978+
PC (excluding FPBs)	Europe, USA, Canada	678	742	751
	Third World	1 221	1 587	1 724
	Third World, excl. China	1 029	1 372	1 478
	World total	**1 899**	**2 329**	**2 475**
FPBs (all types)	Europe, USA, Canada	649	804	868
	Third World	1 143	1 511	1 615
	Third World, excl. China	559	796	900
	World total	**1 792**	**2 315**	**2 483**
FPBs (missile-armed only)	Europe, USA, Canada	173	278	332
	Third World	225	410	479
	Third World, excl. China	145	250	319
	World total	**398**	**688**	**811**
All types of patrol vessel	Europe, USA, Canada	1 327	1 546	1 619
	Third World	2 364	3 098	3 339
	Third World, excl. China	1 588	2 168	2 378
	World total	**3 691**	**4 644**	**4 958**

Table 6.10. Number of countries deploying missile-armed FPBs, and number of missile-armed FPBs deployed: 1960–78 and 1978 including orders

	1960	1965	1970	1975	1978	1978+
Number of countries	1	7	17	33	45	53
Number of FPBs	5	141	282	398	688	811

was at first confined to slow patrol craft, the numbers of which have been growing throughout the last decade at about 10 per cent yearly. Among these states, slowly developing their economies and armed forces, a strong demand for the further growth of coastal naval forces will exist in the future.

2. A number of the Third World countries find themselves embroiled in conflicts, some of them open, others only potential, driving them into extensive arms purchases, including the acquisition of naval vessels. This is best exemplified by countries in the Middle East, in South Asia and in Far East Asia (see table 6.8). It is indicative that these regions were the first among Third World countries to acquire large numbers of modern FPBs. Even after they had acquired large numbers of these vessels in the first half of the last decade, the rate of growth of their light forces is still one of the fastest in the world. The Middle Eastern countries more than doubled their large patrol craft forces (excluding FPBs), and expanded their missile-armed FPB inventory by nearly two and a half times (including outstanding orders) and all types

of FPBs by half during the short span of the past four years. A similar high rate is exhibited by South Asian and Far East Asian countries (including China, North Korea and South Korea). The common feature of these acquisitions is that they are oriented to craft most suitable for purely warfare operations, possessing high fire-power, great manoeuvrability and quick reaction time. Unless the regional tensions and open conflicts are resolved, the acquisitions of this type of naval force will certainly continue.

3. A striking lesson of the military effectiveness of the missile-armed FPBs was provided by their successful use in the 1967 Middle East War and in the 1971 Indo–Pakistani War. With the delayed realization of the potential of fast, small yet large fire-power vessels, and pressed by the sky-rocketing costs of large modern warships, West European countries undertook extensive FPB production programmes [11b, 69b]. Strangely enough, countries which have the biggest shipbuilding potential and which produce modern FPBs are not necessarily identical with those which procure them for their own navies. This is partly to do with their strong feelings about their insular position—as in the case of the United Kingdom and the United States—in relation to naval threats. Such beliefs tend to emphasize the importance of larger vessels as a means of defence against sea-borne attack. Even more importantly, these states still enjoy naval supremacy and are not therefore worried about their coasts—on the contrary, historically speaking they were used to projecting their military power far away from their shores. It seems, however, that even those countries which have not yet begun to procure FPBs for their own navies, will soon do so, given the growing effectiveness of these vessels. This is true of the United States, the United Kingdom and France, all possessing great capacity and technical expertise in constructing modern FPBs and—especially in the case of the UK and France—in selling them in large quantities abroad.

Among the West European countries which have procured large FPB forces, either indigenously built or bought, are FR Germany, Norway, Denmark, Sweden, Greece and Yugoslavia. WTO member countries, excluding the USSR, developed their light naval forces in the 1960s, and after 1970 and later procured rather small quantities. Europe as a whole was the fastest growing market for FPBs, and this tendency still holds (see tables 6.8 and 6.9). Up to 1975 there were 649 of the vessels in Europe, including the USSR; in 1978—only three years later—their number had grown by about 34 per cent to 868 vessels of this type, outstanding orders included. An even faster rate of growth is seen in the category of FPBs armed with missiles. The respective figures for the same years are 173 and 332, thus representing 92 per cent growth. In the category of patrol craft other than FPBs, the developments are not equally dramatic, with the steady growth of these forces by about 10 per cent per year. This is quite understandable, taking into account the fact that modern FPBs are multi-mission vessels, capable of fulfilling both patrol and warfare duties. This multi-mission feature of present FPBs and PC is being extended by the fact that they have increased in size so as to accommodate heavy weapon and electronic loads thus becoming more suitable for patrolling areas larger than merely coastal waters. This trend is exemplified by such vessels as the Soviet 'Nanuchka'- and 'Poti'-class corvettes, the British Offshore Patrol Vessel and Surveillance Corvette, and by a number of new FPBs.

4. So far the major reason for the acquisition of light-weight naval forces has been to fulfil the military interests of states. At present an additional stimulus for enlarging these forces is provided by the growing exploitation of the sea-bed and by the extension of states' exclusive fishery zones. An increasing number of countries justify their new purchases of patrol vessels of various kinds on the grounds of the necessity for protecting their extended interests at sea. Further extensions of territorial waters by certain countries are expected and the establishment of so-called New Economic Zones (NEZs) at sea is certain, despite the fact that the LOS Conference has not yet clarified the legal regime of the seas. Because of the fact that their actions are not as yet regulated by international law, states are anxious to secure their interests by means of naval force. Modern FPBs are the best answer to these needs, since they provide a strike potential deterring much larger naval forces than the less up-to-date coastal military vessels. Thus, a further rapid growth of their number must be expected. All the more so, since FPBs are relatively cheap, when compared with much larger vessels of similar fire-power and sophistication. The most suitable example of the development of light naval forces for protection of extended interests at sea is provided by Norway, Mexico, Peru, Brazil, Argentina, Japan and Indonesia [104, 105]. Apart from the present military conflicts and tensions, the establishment of NEZs seems to be a major source of the present and future naval world-wide arms race.

5. Disregarding regions of open hostilities, there exist several other regions where a dynamic naval arms race is taking place, connected with the phenomenon of the rise of new 'regional superpowers'. The most striking example was provided by Iran, with its ambitious plans for arming. The official reason given was the need for counteracting the growth of leftist states in the region and for filling the alleged 'strategic vacuum' left by the withdrawal of the British forces guarding Western interests in the Persian Gulf [106]. These extensive programmes, if they had been carried out, would without doubt have made Iran the most powerful state in the region. Saudi Arabia attempted to follow

suit by ordering from the USA in 1977 nine corvettes, armed with Harpoon missiles, guns and torpedoes, and several minesweepers; and from France four missile-armed FPBs, as well as a large number of gun-armed coastal patrol craft and several tens of other patrol craft from the United Kingdom.

Another example of similar development is Nigeria, which recently ordered six missile-armed FPBs from FR Germany and France [11c]. These boats, of Type 143 and 'La Combattante III'-class, are armed with Exocet anti-ship missiles, wire-guided torpedoes, two automatic 76-mm guns, and two twin 30-mm guns. These craft, together with the corvettes and patrol craft already in possession of the Nigerian naval forces, will make the country an indisputably superior force in the region.

Yet another development of this kind is taking place in the Indian Ocean, where India, too, is building up new powerful naval forces, apart from expanding its ocean-capable fleet by procuring a number of new frigates and destroyers. In the last two years or so, India has acquired eight new 'Osa'-class missile-armed FPBs and as many as six 'Nanuchka'-class corvettes, armed with SS-N-11 missiles. India also plans to strengthen its local naval shipbuilding capabilities, both in surface warships and submarines—all this in order "to meet any contingency by creating a naval force equal in size and competence to the naval forces of any one of the superpowers normally operating in the area" [107a]. Another reason given, to quote the same Indian source on developments in the littoral states of the Indian Ocean, is that "the navies of some of these states are planned to be much bigger than what appears necessary for their legitimate requirements" [107b]. It is interesting to point out that the quoted Indian ambitions serve as a justification for those Australian hawks who are eager to convince their government of the necessity for acquiring several large warships [108] in addition to the 15 modern patrol craft already ordered. There are other regions where similar, though not as clearly articulated wishes for attainment of a strong military position on the part of some states will duly initiate a naval arms race, much of this being brought about by the acquisition of modern FPBs.

6. It is sometimes difficult to find a more or less logical explanation for the creation by some states of an ultra-modern if sparse naval force consisting of a few FPBs, when in the surrounding region no other state possesses such craft. This applies particularly to a number of African countries. It is probable that the best explanation for their early acquisitions of FPBs is the prestige attached to these modern, electronically sophisticated vessels [11b]. Now, when new reasons are being put forward for the expansion of coastal patrol forces, several other states

will follow suit, partly justified in their acquisitions by the actions of their neighbours.

7. Several navies operate numerous but dated patrol forces, not suitable for extended patrols further offshore. Since the supply potential is vast, it is reasonable to expect vigorous modernization and replacement, most probably connected with the desire to increase the technical qualities and hence the military potential of these forces. This may be particularly true in the case of the Latin American and Far East Asian countries.

8. Among the reasons for the rapid expansion of light naval forces are the political, military or economic interests of several industrialized states in supplying these types of ships to other countries. In the case of the Soviet Union and China, these interests are usually connected with the political or ideological affiliation of the recipient country [109]. Apart from such political motivations, it seems that the upsurge of popularity of FPBs may partly be a response to the marketing activities of the Western and other industrialized countries, such as France, FR Germany, the UK and Israel, which through this new fashion in armaments expect to gain greatly in orders for their otherwise not-too-busy shipyards. By competing on the market, the potential suppliers accelerate the technological naval arms race among the Third World countries.

All of these above-mentioned factors act more or less simultaneously. As tables 6.8 and 6.9 indicate, the cumulative effects of these factors are staggering; the number of missile-armed FPBs in the world grew in so short a time-span as 1975 to 1978 from 398 to 811 (outstanding orders included), that is, more than doubled; the number of all types of FPBs grew in the same time from 1 972 to 2 483; and the number of other patrol craft (including missile-armed corvettes) grew from 1 899 to 2 475. There is now only one region in the world where FPB forces do not exist so far, namely, Australia and Oceania. According to tables 6.8, 6.9 and 6.10, the numbers of missile-armed FPBs, that is vessels most suitable in a combat role, grew most rapidly in Europe, the Middle East and in Far East Asia. The proliferation of these forces over a longer period of time—from 1960 to 1978—is shown in table 6.10. Whereas in 1960 only one state possessed FPBs, in 1970 17 countries, and in 1978 more than one-third of the countries (122) having direct access to the sea—45 to be precise—were already operating FPB forces.

Available figures indicate that the naval arms race in the area of light vessels has now gathered momentum. Several factors, indicated above, will continue to urge states throughout the world to acquire new modern patrol vessels. This development cannot fail to cause serious aggravation of some regional conflicts and tensions. It will also deprive several countries of much needed resources, despite the fact that the

FPBs and other small patrol vessels are cheaper to buy and to maintain in comparison with larger vessels. The poorer states must measure the costs according to their resources and not to the theoretical cost of large modern warships.[1] In addition, the highly sophisticated equipment and weapons on several vessels will increase the dependence of less advanced states on spare parts and repair services from the supplying states.

V. Conclusions

An interest in maintaining naval forces is as old as the human utilization of sea-waters, and has been fortified by industrial progress. The naval arms race is both qualitative and quantitative, the most industrialized countries deploying the largest and most capable navies. In recent decades, however, the rising costs of warships have changed the direction of naval expansion from the acquisition of large warships to the acquisition of smaller and cheaper vessels. Although the numbers and sizes of modern warships are declining, their striking power has not diminished correspondingly, due to the technological sophistication of the ships themselves and the weapons they carry. Technological advancement of naval weapon systems is therefore the main feature of the contemporary naval arms race as far as the highly developed states are concerned.

Because of several geopolitical, economic and technological factors the participation of less developed countries in the global naval expansion is growing. This interest in the acquisition of naval forces is visible first of all in the numerical expansion of light naval vessels. Their possession allows small or virtually non-existent navies to grow quickly into relatively powerful and modern ones.

Another discernible major characteristic of the present naval arms race is the growing pace of the sophistication of naval weapon systems. This is a result of the growing number of states taking part in technological competition. Weapons are growing in sophistication because the more sophisticated a weapon, the better it is likely to sell. The result is that many new types of naval weapons are being designed, but their generations are appearing so fast that not all of them can even be deployed. In general, the effectiveness of warships and their weapons increases through the interaction of several improved qualities, such as speed of attack or defence, accuracy of fire irrespective of distance, fast and real-time target acquisition, and communication and command between decision centres.

[1] Thus three missile-armed FPBs for Brunei (150-ton displacement, 37-m length) cost over $100 million [110]; two 'Spica'-class FPBs for Trinidad and Tobago cost about 100 million Swedish crowns [62]; and three 26.5-m long fishery protection vessels for Senegal cost $6.7 million [71].

The rapidly escalating naval arms race is expensive and, more importantly, can cause serious aggravation of the political situation, globally or regionally, although its impact is as yet difficult to grasp. There is therefore a growing need to direct more attention to this aspect of the arms race.

References

1. Larson, D. L., 'Security, disarmament and the law of the sea', *Marine Policy*, Vol. 3, No. 1, January 1979.
   (a) —, pp. 40–58.
   (b) —, p. 43.
2. Lehman, J., *Aircraft Carriers: The Real Choices*, Washington Papers No. 52 (Center for Strategic and International Studies, Georgetown University, Washington, D.C., 1978).
   (a) —, pp. 45–49.
   (b) —, p. 5.
3. Gervasi, T., *Arsenal of Democracy, American Weapons Available for Exports* (Grove Press, New York, 1978).
4. *National Defense* (Journal of the American Defense Preparedness Asscn.), Vol. 63, No. 351, November–December 1978).
   (a) —, Snouck-Hurgronje, J. W., 'US Navy ship design', p. 37.
   (b) —, Adler, R. E., 'Advanced navy ships', p. 42.
5. Cairl, M. A., 'Through-deck cruiser: the new capital ship', *US Naval Institute Proceedings*, Vol. 104/4/910, December 1978, pp. 34–42.
6. *NATO's Fifteen Nations*, Special Edition 1978, Vol. 23.
   (a) —, Eliot, C., 'Fast attack craft', p. 144.
   (b) —, Hayward, T. B., 'The United States Navy', p. 108.
   (c) —, —, p. 107.
7. *Military Electronics/Countermeasures*, Vol. 4, No. 7, July 1978.
8. *Warships and Naval Systems, International Defense Review, Special Series.*
   (a) —, p. 61.
   (b) —, pp. 61 – 74.
   (c) —, pp. 75–85.
   (d) —, pp. 155–60.
9. *The Military Balance 1978–79* (International Institute for Strategic Studies, London, 1978).
   (a) —, p. 100.
   (b) —, pp. 92–97.
   (c) —, pp. 114–18.
   (d) —, p. 117.
10. *Aviation and Marine International*, Vol. 5, No. 48, October/November 1977.
11. *Electronic Warfare/Defence Electronics*, Vol. 10, No. 12, December 1978.

(a) —, p. 78.
(b) —, pp. 45–46 and 76–78.
(c) —, p. 46.

12. *Hearings on Military Posture and HR 5068 and HR 1755*, Department of Defense Authorization for Appropriations for FY 1978 before the Committee on Armed Services, House of Representatives, 95th Congress, 1st Session, Part 4, Seapower and Strategic and Critical Materials Subcommittee—Navy Ship-building and Conversion (SCN) Program for FY 1978, Torpedoes and Other Weapons (US Government Printing Office, Washington, D.C., 1977).
    (a) —, pp. 311–69.
    (b) —, pp. 121–39.
13. *Hearings before a Subcommittee of the Committee on Appropriations*, House of Representatives, 95th Congress, 1st session, Part 7, Rescission of Appropriations, FY 1977 (US Government Printing Office, Washington, D.C., 1977), pp. 1–41.
14. *Jane's Fighting Ships 1978–79*, ed. J. E. Moore (Macdonald and Jane's Ltd., London, 1978).
15. McClelland, J. J., 'Mission conversions for the missile hydrofoil', *US Naval Institute Proceedings*, Vol. 104/6/904, June 1978, pp. 115–19.
16. McLeavy, R., 'Naval foilcraft—broader roles ahead', *Command*, Vol. 1, No. 1, November/December 1978, pp. 47–54.
17. *US Naval Institute Proceedings*, Vol. 104/3/901, March 1978.
    (a) —, Adler, R. E., 'In the navy's future the small, fast surface ship', pp. 103–11.
    (b) —, Olson, S. R., 'Seakeeping—and the SWATH design', pp. 139–46.
    (c) —, Leopold, R., 'Technology and future warships design', pp. 36–47.
    (d) —, Polmar, N., 'Containerized weapons . . . and merchant warships', pp. 133–36.
    (e) —, Hammond, R. E. and Tierney, P., 'The LAMPShip team', pp. 154–60.
18. Elson, B. M., 'Air cushion vehicles readied for testing', *Aviation Week and Space Technology*, Vol. 106, No. 21, 23 May 1977, pp. 53–58.
19. *Military Review*, Vol. 58, No. 12, December 1978, p. 67.
20. *Jane's Surface Skimmers 1973–74, Hovercraft and Hydrofoils*, 7th edition, ed. R. McLeavy (Sampson Low, Marston and Co., London, 1973).
21. *National Defense*, Vol. 60, No. 336, May/June 1976.
22. Bonsignore, E., 'On foils and cushions', *Aviation and Marine International*, Vol. 5, No. 40, January 1977, pp. 41–48.
23. *Aviation Week and Space Technology*, Vol. 108, No. 11, 13 March 1978, p. 125.
24. *Maritime Defence International*, Vol. 3, No. 11, November 1978, p. 437.
25. *Soldat und Technik*, Vol. 21, September 1978, p. 461.

26. Bonsignore, E., 'The Tarawa class: a new philosophy for landing operations', *Si Vis Pacem Para Bellum*, Vol. 2, No. 1, January 1978, pp. 50–58.
27. Leopold, R., 'Technologically improved warships: a partial answer to a reduced fleet', *International Security*, Vol. 2, No. 4, Spring 1978, pp. 185–94.
28. Rhea, J., 'Advanced concepts—a serious US Navy look into the future', *Maritime Defence International*, Vol. 3, No. 2, February 1978, pp. 59–62.
29. *Aviation and Marine International*, Vol. 5, No. 45, June 1977.
30. *Armed Forces Journal International*, Vol. 115, No. 11, July 1978.
31. *Maritime Defence International*, Vol. 3, No. 7, July 1978, p. 286.
32. *Securing the Seas: Soviet Naval Challenge and Western Alliance Options, The Atlantic Council's Working Group on Securing the Seas* (Atlantic Council, Washington, D.C., October 1978).
    (a) —, pp. 50–52.
    (b) —, p. 36.
    (c) —, pp. 19–21.
    (d) —, pp. 26 and 61.
33. Morris, E., *The Russian Navy: Myth and Reality* (Hamish Hamilton, London, 1977), Appendix 2.
34. Collins, J. M., *American and Soviet Military Trends Since the Cuban Missile Crisis* (Center for Strategic and International Studies, Georgetown University, Washington, D.C., 1978).
    (a) —, p. 273.
    (b) —, p. 65.
35. Singh, K. R., 'Ship-to-ship missile system: the new challenge', *Institute for Defence Studies and Analyses Journal*, Vol.5, No. 3, January 1973.
36. *Jane's Weapon Systems 1978/79*, ed. R. T. Pretty (Macdonald and Jane's Ltd., London, 1978).
37. *Flight International*, 10 June 1978, pp. 1786–99.
38. *R.U.S.I. and Brassey's Defence Yearbook 1977/78* (Brassey's Publishers Ltd., London, 1977).
    (a) —, p. 219.
    (b) —, pp. 226–33.
    (c) —, pp. 233–41.
39. Pfaltzgraph, R. L. and Davis, J. K., *The Cruise Missile: Bargaining Chip or Defense Bargain?* (Institute for Foreign Policy Analysis, Inc., Cambridge, Mass., 1977).
    (a) —, pp. 5–7.
    (b) —, pp. 17–18.
40. *Military Electronics/Countermeasures*, Vol. 4, No. 9, September 1978.
41. *Hearings before the Committee on Armed Services*, 95th Congress, 1st session on S.1210, Part 7, Tactical Air (US Government Printing Office, Washington, D.C., 1977).
    (a) —, pp. 4701–709.

(b) —, pp. 5012–5020.
(c) —, pp. 4948–52.
(d) —, pp. 4871–941.
(e) —, p. 4903.
(f) —, pp. 4942–56 and 4960–64.
(g) —, pp. 4957–60.

42. *Aviation Week and Space Technology*, Vol. 100, No. 8, 25 February 1974, pp. 32–35.
43. *Aviation Week and Space Technology*, Vol. 106, No. 14, 4 April 1977.
44. Tsipis, K., 'Cruise missiles', *Scientific American*, Vol. 236, No. 2, February 1977, pp. 23.
45. Huisken, R., 'The Tomahawk anti-shipping missile', *Pacific Defence Reporter*, Vol. 5, No. 1, July 1978, pp. 38–39.
46. Ciampi, A., 'The problem of armament', *Aviation and Marine International*, Vol. 5, No. 42, March 1977.
47. *Si Vis Pacem Para Bellum*, Vol. 1, No. 1, December 1977.
48. *Department of Defense FY 1979*, Research and Development Programs Guide, Part 1, The Information Group (US Government Printing Office, Washington, D.C., 1978).
    (a) —, p. 140 N.
    (b) —, p. 142 N.
49. Sweetman, B. and Gunston, G., *Soviet Air Power, An Illustrated Encyclopedia of the Warsaw Pact Air Forces Today* (Salamander Books, Ltd., London, 1978.
50. *Dagens Nyheter* (Stockholm), 24 February 1979.
51. Perry, G. E., 'Russian ocean surveillance satellites', *Royal Air Force Quarterly*, Vol. 18, Spring 1978, pp. 60–67.
52. *The Department of Defense Program of Research, Developments, Test and Evaluation, FY 1978*, Statement by Dr M. R. Currie, Director of Defense Research and Engineering to the Congress of the United States, 95th Congress, 1st session, 18 January 1977.
    (a) —, p. IV–69.
    (b) —, pp. IV–66–68.
    (c) —, p. IV–66.
53. *National Defense*, Vol. 62, No. 346, February 1978.
54. *Aviation Week and Space Technology*, Vol. 106, No. 8, 21 February 1977.
55. *Aviation Week and Space Technology*, Vol. 109, No. 9, 28 August 1978.
56. *Hearings before a Subcommittee of the Committee on Appropriations*, House of Representatives, 95th Congress, 1st session, Part 2 (US Government Printing Office, Washington, D.C., 1977), pp. 332–33.
57. *Maritime Defence International*, Vol. 3, No. 4, April 1978.
58. *Defense and Foreign Affairs Digest*, Vol. 6, February 1978.
59. *Armed Forces Journal International*, Vol. 115, No. 6, February 1978, pp. 28–29.
60. *Electronic Warfare/Defence Electronics*, Vol. 10, No. 11, November 1978, p. 18.

61. Report of Secretary of Defense D. H. Rumsfeld to the Congress on the FY 1977 Budget and Its Implications for the FY 1978 Authorization Request and the FY 1977–1981 Defense Programs, 27 January 1976 (US Government Printing Office, Washington, D.C., 1976), p. 170.
62. *Maritime Defence International*, Vol. 3, No. 10, October 1978.
63. Gravlin, E. S., 'US Navy low volume ramjet technology', *Combat Aircraft, International Defence Review, Special Series*, pp. 163–64.
64. *Interavia Air Letter*, No. 8953, 27 February 1978.
65. Singh, K. R., 'Neutralizing the anti-ship missiles', *Institute for Defence Studies and Analyses Journal*, Vol. IX, No. 1, July–September 1976, pp. 1–13.
66. *Aviation and Marine International*, Vol. VI, No. 55, September 1978, pp. 37–46.
67. *US Naval Institute Proceedings,* Vol. 104/2/900, February 1978.
    (a) —, Bussert, J., 'Soviet naval electronic technology', p. 107.
    (b) —, —, pp. 105–108.
    (c) —, Lambell, D., 'Trends in tactical command and control', pp. 99–103.
68. Kemp, R. M., 'Versatile navy weapon', *National Defense*, Vol. 60, No. 337, July/August 1976, pp. 44–47.
69. Hartman, R., 'Shipboard defence: EW proving its mettle', *Electronic Warfare/Defence Electronics*, Vol. 10, No. 8, August 1978.
    (a) —, pp. 49–50.
    (b) —, pp. 55–59.
70. *Interavia Air Letter*, No. 9026, 15 June 1978.
71. *Aviation and Marine International*, Vol. 5, No. 45, June 1977.
72. *Si Vis Pacem Para Bellum*, Vol. 2, No. 2, February 1978.
73. *Combat Fleets of the World 1976/77: Their Ships, Aircraft, and Armament,* ed. J. L. Couhat (Arms and Armour Press, London, 1976, p. 449.
74. *National Defense*, Vol. 61, No. 339, November–December 1976, pp. 195–98.
75. *Pacific Defence Reporter*, Vol. 2, No. 2, August 1978, pp. 44–48.
76. *Hearings before the Committee on Armed Services*, US Senate, 95th Congress, 2nd session, on S. 2571, Part 8, Research and Development (US Government Printing Office, Washington, D.C., 1978), p. 6184.
77. Corlett, R., 'The Mark 48 torpedo—warship killer', *Maritime Defence International*, Vol. 3, No. 5, May 1978, pp. 159–61.
78. *Military Technology and Economics*, 4/1978.
79. *Hearings before a Subcommittee of the Committee on Appropriations,* House of Representatives, 93rd Congress, 2nd session, Part 7, Procurement (US Government Printing Office, Washington, D.C., 1974), pp. 598–600.
80. *Hearings before the Committee on Armed Services*, US Senate, 95th Congress, 1st session, on S. 1210, Part 8, Research and Development (US Government Printing Office, Washington, D.C., 1977), pp. 5472–74.

81. *National Defense*, Vol. 62, No. 348, May/June 1978.
82. Keen, T. J., 'A new kind of navy', *US Naval Institute Proceedings,* Vol. 104/1/899, January 1978, p. 40.
83. Deitchman, S. J., 'Designing the fleet and its air arm', *Astronautics and Aeronautics*, Vol. 16, No. 11, November 1978.
(a) —, p. 29.
(b) —, Table T-7, p. 25.
84. Turner, S., 'The naval balance: not just a numbers game', *Foreign Affairs*, Vol. 55, No. 2, January 1977.
(a) —, p. 339.
(b) —, p. 348.
85. *Soviet Naval Developments, Context and Capability, Papers Related to Russia's Maritime Interests*, ed. M. MccGwire (Centre for Foreign Policy Studies, Department of Political Science, Dalhousie University, Halifax, N.S., 1973).
(a) —, p. 316.
86. *Joint Hearings before the Joint Senate–House Armed Services Subcommittees of the Senate and House Armed Services Committees on CVAN-70 Aircraft Carrier*, 91st Congress, 2nd session (US Government Printing Office, Washington, D.C., 1970), pp. 163–65.
87. Friedman, N., with a contribution by H. Kahn and W. Scheider, Jr., *Non-standard Forms of Naval Warfare: Tactical and Technological Requirements*, HI-2351-RR (Hudson Institute, New York, 31 October 1975).
(a) —, p. 3.
(b) —, pp. 8–20.
(c) —, p. 1.
88. Weinland, R. G., *Soviet Naval Operations—Ten years of Change*, Professional Paper 12 (Center for Naval Analyses, Arlington, Va., August 1974).
89. *SIPRI Yearbook of World Armaments and Disarmament 1969/70*, (Almqvist & Wiksell, Stockholm, Stockholm International Peace Research Institute, 1970).
(a) —, pp. 307–308.
(b) —, pp. 308–10 and 313–18.
90. Department of Defense Annual Report, FY 1979, H. Brown, Secretary of Defense, 2 February 1978, Chart II B-2, p. 166.
91. Blechman, B. M., *The Changing Soviet Navy, A Staff Paper* (Brookings Institution, Washington, D.C., 1973).
(a) —, pp. 7–8.
92. *Allocation of Resources in the Soviet Union and China—1977*, Hearings before the Senate Committee on Priorities and Economy in Government and the Joint Economic Committee, US Congress, 95th Congress, 1st session (US Government Printing Office, Washington, D.C., 1977), Part 3, p. 93.
93. *Weyers Flotten Taschenbuch 1977/78, Warships of the World*, compiled

by G. Albrecht (Bernard und Graefe Verlag für Wehrwessen, Munich, 1978).
94. *Interavia Air Letter*, No. 9184, 1 February 1979.
95. *The US Sea Control Mission: Forces, Capabilities, and Requirements, Background Paper, June 1977,* US Congress, Congressional Budget Office (Washington, D.C., 1977), p. 9.
96. *Aviation Week and Space Technology*, Vol. 106, No. 5, 31 January 1977.
97. *Aviation Week and Space Technology,* Vol. 106, No. 6, 7 February 1977.
98. *Aviation Week and Space Technology,* Vol. 107, No. 22, 28 November 1977.
99. Marriot, J., 'Fire power of the striking fleet', *NATO's Fifteen Nations,* Vol. 23, No. 2, April–May 1978, p. 50.
100. Vego, M., 'Soviet naval electronics: getting set for the eighties', *Defense and Foreign Affairs Digest*, Vol. 6, No. 11, November 1978, pp. 12–22.
101. Kassig, D., *Protecting the Fleet*, Professional Paper no. 210 (Center for Naval Analysis, Arlington, Va., December 1977).
102. Eustace, H. F., *A US View of Naval EW, International Defence Review, Special Series: Electronic Warfare*, p. 50.
103. *NATO's Fifteen Nations*, Vol. 22, No. 6, December 1977/January 1978.
    (a) —, pp. 89–93.
104. *Aviation and Marine International*, Vol. 5, No. 44, May 1977.
105. *Asahi Evening News*, 16 October 1978.
106. Crowe, W. J., 'The Persian Gulf: central or peripheral to United States strategy?' *US Naval Institute Proceedings*, Vol. 104/5/903, May 1978, p. 194.
107. Chatterji, A. K., 'Indian Navy in the eighties', *The Chanakya Defence Annual 1978,* ed. R. Kaul (Chanakya Publishing House, Allahabad, 1978).
    (a) —, p. 98.
    (b) —, p. 99.
108. Grazebrook, A. W., 'The need for fixed wing seaborne air power', *Pacific Defence Reporter*, Vol. 5, No. 4, October 1978, pp. 14–16.
109. *Electronic Warfare/Defence Electronics*, Vol. 10, No. 9, September 1978, pp. 69–75.
110. *Maritime Defence International*, Vol. 3, No. 9, September 1978.
111. Berman, R. P., *Soviet Air Power in Transition* (The Brookings Institution, Washington, D.C., 1978).
112. *Department of Defense Authorization for Appropriations for FY 1979*, Hearings before the Committee on Armed Services, US Senate, 95th Congress, 2nd session, on S. 2571, Part 8, Research and Development (US Government Printing Office, Washington, D.C., 1978).
113. *Air Force Magazine*, Vol. 62, No. 2, February 1979, pp. 34–37.

114. Polmar, N., 'Soviet Naval Aviation', *Air Force Magazine*, Vol. 61, No. 3, March 1978, p. 67.
115. Rasmussen, P. H., 'The Soviet naval air force. Development, organization and capabilities', *International Defense Review*, Vol. 11, No. 5, 1978, pp. 689–95.
116. *International Defense Review*, Vol. 10, No. 6, December 1977.

Acronyms and abbreviations

AA weapon	Anti-air weapon
AAM	Air-to-air-missile
ACV	Air-cushion vehicle
AEW	Airborne early warning
ARM	Anti-radiation missile
ASM	Air-to-surface (ship) missile
ASMD	Anti-ship missile defence
ASSM	Anti-ship supersonic missile
ASW	Anti-submarine warfare
AWACS	Airborne warning and control system
CIWS	Close-in weapon system
CLOS	Command to line of sight
DARPA	Defence Advanced Research Project Agency
ECM	Electronic countermeasures
ECCM	Electronic counter-countermeasures
ELF	Extremely low frequency
ELINT	Electronic intelligence
EW	Electronic warfare
FCC	Fleet command center
FCS	Fire control system
FLTSATCOM	Fleet satellite communications
FPB	Fast patrol boat
HE	High explosive
IFF	Identification friend or foe
IR	Infra-red
IIR	Imaging infra-red
LAMPS	Light airborne multi-purpose system
LASH	Lighter aboard ship
LCC	Amphibious command ship
LHA	Amphibious command ship (helicopter)
LKA	Amphibious cargo ship
LPH	Amphibious assault ship (helicopter)
LPD	Amphibious transport dock
LST	Amphibious tank landing ship
LVRJ	Low volume ramjet
MCLWGS	Major calibre lightweight gun system

MICRAD	Microwave radiometer
MRCA	Multi-role combat aircraft
NAVSTAR-GPS	Navigation satellite timing and ranging—global positioning system
NTDS	Naval tactical data system
OTH	Over-the-horizon
PC	Patrol craft
PGM	Precision-guided munition
PHM	Patrol hydrofoil missile
RF	Radio frequency
RPV	Remotely piloted vehicle
SAC	Strategic Air Command (of the USA)
SALGP	Semi-active laser guided projectile
SAM	Surface- (or Ship-) to-air missile
SAN	Surface-to-air (naval) missile
SDMS	Shipboard data multiplex system
SES	Surface effect ship
SIGINT	Signal intelligence
SIRCS	Shipboard intermediate range combat system
SLAM	Surface launched air missile
SS	Submarine (non-nuclear propulsion)
SSBN	Nuclear-powered ballistic missile submarine
SSG	Guided-missile submarine
SSGN	Nuclear-powered guided-missile submarine
SSIXS	Submarine satellite information exchange subsystem
SSM	Surface- (ship-) to-surface (-ship) missile
SSN	Nuclear-powered submarine
SSN	Ship-to-ship (naval) missile
SWATH	Small waterplane area twin hull
TASES	Tactical airborne signals exploitation system
TFCC	Tactical flag command center
V/STOL	Vertical/Short take-off and landing

7. Command and control of the sea-based nuclear deterrent: the possibility of a counterforce role

Square-bracketed numbers, thus [1], *refer to the list of references on page 417.*

I. Introduction

Nuclear deterrence is based on the assumption that no nation will contemplate nuclear attack on another if the nation to be attacked has an assured capability to respond with prompt and massive destruction of the attacking nation's cities.

A capability for mutual assured retaliation requires that at least part of the nuclear weaponry of each side be deployed in such a way as to be immune to first strike by the other side. For this reason, most land-based intercontinental ballistic missiles (ICBMs) are protected in underground silos which can withstand the sort of over-pressures generated by nearby explosions. However, the most important way of enhancing survivability has been for each side to keep a proportion of its deterrent forces hidden within the oceans on board nuclear-powered submarines.

The invulnerability of the submarine-launched ballistic missile (SLBM) deterrent rests on two important assumptions. These are (*a*) that the nuclear submarines are essentially undetectable and hence untargetable, and (*b*) that communication systems are reliable enough to guarantee that, even in the chaos accompanying the outbreak of general nuclear war, orders to launch missiles will still get through to a sufficient number of submarines for a sizeable retaliatory attack to take place.

The first assumption is concerned with the big question of just how effective anti-submarine warfare (ASW) detection systems are becoming. Although there is no breakthrough imminent which is likely suddenly to render the oceans militarily 'transparent', there is evidence of a number of lines of technological progress currently coming to fruition which, taken together, will offer a high probability of detecting missile submarines anywhere in the ocean. This technological progress is described in chapter 8, on 'Strategic anti-submarine warfare and its implications for a counterforce first strike'.

The second assumption is also open to strong doubt. Despite the enormous research effort that has gone into seeking more secure communication modes, serious doubts exist as to whether communications really are reliable enough to guarantee that during a nuclear exchange orders for a retaliatory attack will in fact get from command authorities to individual submarines.

If survivability of both the submarines and their communications systems cannot be guaranteed, then there will be an increased temptation to adapt the SLBM system as a whole for use in a first-strike counterforce role. In other words, the SLBMs will be redirected against the missile silos and other strategic weapons of the other side, instead of against cities, and preparations will be made for launch of SLBMs to take place as part of the opening move of a nuclear attack. A counterforce doctrine is inherently destabilizing in that it creates pressures for both sides to launch pre-emptive attacks, while the second-strike doctrine, despite all its faults, does have defensive connotations, and does seem to have had a stabilizing effect.

Until now each nuclear power has had reasonable assurance that the other side's SLBM forces were indeed intended only for deterrent (second-strike) roles. This assurance came from the widely accepted belief that SLBMs were only accurate enough for destroying soft targets, such as cities, and not hard targets, such as missile silos.

The traditional view has been that the navigational uncertainties of the missile submarines have been such that the accuracy/explosive yield combination of the SLBMs has been inadequate for the destruction of hard targets.

There is, of course, no doubt that SLBMs are counterforce weapons in the sense that some of them are targeted against soft military sites, such as airfields. However, destruction of such targets could only reduce retaliatory capacity, not eliminate it, so the effect on the basic strategic equation has been unimportant.

Now, however, there are very real grounds for concern about the possibility of SLBMs being sufficiently accurate to be effective against the entire spectrum of land counterforce targets.

A number of technological developments have already contributed to a reduction in the navigational uncertainties of the submarine, and, more important, techniques are being developed or implemented for mid-course and terminal guidance of SLBMs that eliminate altogether the missile errors resulting from navigational uncertainties.

This chapter looks first at developments in missile submarine command and control systems for the missile submarines, and then at the various improvements that are being made to enhance the accuracy of the SLBMs.

Table 7.1. US and Soviet ballistic missile submarines, 1979

	Submarine type	Number of submarines	Total number of missiles	Explosive yield and number of RVs per missile	Approximate total number of RVs
USA	Polaris	10	160	3 x 200 kt or 1 x 1 Mt	320
	Poseidon	31	496	c.10 x 50 kt	c. 4 960
Total, USA		**41**	**656**		**5 280**
USSR	Golf (diesel)	(<19)	(<57)	1 x 1 Mt	57
	Hotel	7	21	1 x 1 Mt	21
	Yankee	34	544	3 x (kt range) or 1 x 1 Mt	1 080
	Delta	30	412	1 x 1 Mt or 3 x 200 Mt	540
Total, USSR		**90**	**1 034**		**1 698**

Sources: References [1, 2], with consideration of other sources.

II. The US and Soviet missile submarine fleets[1]

The USA has 41 operational nuclear-powered ballistic missile-equipped submarines, or SSBNs, about half of which are on station and ready to fire their missiles at any particular time. Each submarine carries 16 missiles. The original Polaris missile, first deployed in 1960, had a range of 2 000 km and a single re-entry vehicle (RV). The A3 version still in use has a range of up to 4 600 km, with each missile generally carrying three RVs of about 200 kt each. Only 10 submarines still carry Polaris missiles; the remainder have been converted to Poseidon. Poseidon has about the same range as the Polaris A3, but is much more accurate, and carries multiple independently targetable re-entry vehicles (MIRVs), each of 40-kt energy yield. 'MIRVing' allows one Poseidon missile to be used against up to 14 separate targets. Poseidon became operational in March 1971, and thanks to MIRVing the USA can now land warheads on over 5 000 separate targets using missile submarines alone. Each of the targets would be subjected to a blast about three times as powerful as that delivered by the Hiroshima bomb, which was about 15 kt.

The Soviet Union has about 90 ballistic missile submarines, of at least four different types and carrying at least five different types of missile. There still remain perhaps as many as 19 of the 1960 vintage 'Golf'-class diesel-powered submarine carrying SS-N-4 or SS-N-5 1 300-km range missiles with 1- to 2-Mt warheads. There are seven 'Hotel'-class

[1] The ballistic missiles submarine fleets have been previously discussed in the *SIPRI Yearbooks 1968/69* and *1969/70*, and in the 1974 SIPRI publication *Tactical and Strategic Antisubmarine Warfare*. The numerical strengths of the two fleets are summarized in table 7.1 and are given in more detail in appendix 7A.

submarines, similar to Golf but nuclear-powered. The 'Yankee'-class submarine, first deployed in 1968 and with about 30 now operational, is a large submarine comparable to the US Polaris boats, each carrying 16 3 000-km range SS-N-6 missiles with 1- to 2-Mt warheads. A later version of the SS-N-6 carries three RVs on each missile. The 'Delta'-class submarine first went on patrol in 1974. The earlier version, of which there are 17, carries 12 missiles. A 'stretched' version, the Delta II/III, carrying 16 missiles is now in production, and about 13 of these are now in the water. A 24-missile version has been described by some Western sources, but its existence is flatly denied by the US Defense Intelligence Agency.

The oldest US submarines are now reaching retirement age and are due to be replaced by a new class of submarine carrying the Trident missile. The new submarine will carry 24 missiles and will cruise at greater depths, at higher speeds, and with less emission of noise than present submarines. The Trident I missile, currently under test, will be notable for its 7 000-km range, comparable to that carried by the Soviet Delta submarines, and each missile will carry 8 MIRVs. Trident I will be backfitted to at least 12 of the existing Poseidon boats, starting late 1979. Development of a Trident II missile is also under way. Trident II will be a bigger missile which will fit only Trident submarines, and its most important features will be the high accuracy of its mid-course and/or terminally guided RVs and its longer range.

The Soviet Union is also introducing new missiles. The SS-N-X17, a follow-on to the SS-N-6, of about 5 000-km range, will probably carry a payload of three 1- to 2-Mt MIRVs. The SS-N-18 is a similarly MIRVed follow-on to the SS-N-8. While all earlier Soviet SLBMs had storable-liquid propellants, the SS-N-6 and SS-N-18 may have solid propellants, as have all US SLBMs from the beginning.

If only the figures for numbers of submarines are examined, the Soviet Union appears to have a distinct advantage—of about 90 to 41. Even allowing for the geographic disadvantages of the Soviet Union, these figures are significant—the large number of Soviet submarines could complicate US pre-emptive destruction. If numbers of missiles are compared, the Soviet Union again appears to have an advantage—1 034 to 656. In terms of RVs, however, this advantage is reversed—the USA has about 5 000 as compared with about 1 700 for the Soviet Union. This ratio gives a reasonable indication of the relative 'countervalue' capabilities of the USA and the USSR—the USA can inflict damage greater than that inflicted on Hiroshima on about 5 000 targets, while the USSR can inflict very much greater damage on about 1 700 targets. (A 1-Mt explosion will destroy all housing in an area of about 50 km^2.) The greater energy yield of the Soviet warheads is more or less balanced by the greater accuracy of the US warheads.

If counterforce capabilities are to be compared, then somewhat different considerations apply. Here the weapon must deliver a large amount of explosive energy to a very small target, and therefore accuracy becomes much more important than for countervalue targets. The counterforce effectiveness of a warhead can be summarized in the concept of 'lethality' or K, derived from the equation:

$$K = Y^{2/3}/\mathrm{CEP}^2$$

where Y = yield in Mt, and CEP = accuracy (circular error probable) in nautical miles [3].

Table 7.2. Hard target lethality of SLBMs, 1978

SLBM	Accuracy of re-entry vehicle (nautical miles) CEP	Explosive yield of warhead (megatons) Y	Lethality per re-entry vehicle K	Number of re-entry vehicles per missile n	Total number of missiles m	Total lethality of missile force $K\,n\,m$
Polaris A3	0.5	0.2	1.37	3	160	658
Poseidon C3	0.3	0.04	1.30	10	496	6 448
Total lethality						**7 106**
SS-N-4/5	2.0	1[a]	0.25	1	78	20
SS-N-6	1.5	1.0	0.45	1	528	238
SS-N-8	0.8	1.0	1.56	1	354	552
Total lethality						**810**

[a] Assumed figure.

Sources: References [3, 4], with updating.

Table 7.2 gives approximate figures for the lethalities of the SLBM forces of the USA and the USSR.[2] Lethalities in this table may be underestimated in so far as MIRVing is not taken into account. MIRVing, in general, increases hard-target kill probability [5]. The figures indicate the vastly greater effectiveness of the US SLBM arsenal —an effectiveness conferred in particular by the greater accuracy of the US missiles.

A further factor that should be taken into account, especially when considering the possibility of a first strike, is *readiness*, that is, the number of submarines or missiles which are ready for use at any particular time. The USA, thanks to tight maintenance schedules and double crewing, has on average 55 per cent of its submarines at sea. This figure will increase to about 65 per cent when Trident is deployed in sufficient numbers. The Soviet Union, however, according to US

[2] See also appendix 7A.

figures [7], has only 11 per cent of its submarines at sea on average,[3] and never demonstrates a 'surge capacity' of putting more to sea at any particular time. Assuming that the numbers of submarines of different classes at sea are in proportion to the numbers of submarines in each class, this would seem to indicate that if general nuclear war were to break out suddenly and without warning (admittedly an unlikely situation), the USA might have about 2 600 SLBM RVs safe from a first-strike attack, while the Soviet Union might have as few as 187.[4] The question of readiness also has important implications in assessing for each side the magnitude of the problem of pre-emptively destroying the other side's missile submarines. If there were no advance warning, a pre-emptive attack by the USA would only have to locate and destroy about 9 submarines, while a similar attack by the Soviet Union would have to locate and destroy about 20. (Submarines at sea would be viable as second-strike systems, even if not in their patrol areas; submarines in port would be sitting ducks for a pre-emptive attack.)

III. Communication, navigation and surveillance systems associated with ballistic missile submarines

The mobility of the missile submarine is an important factor in survivability, but it also creates two problems. One is that guaranteeing secure transmission of orders to the submarines is much more difficult than it is for the land-based missiles. Communication systems are notoriously vulnerable to all kinds of enemy action, not to mention natural phenomena. In order to make sure that the message to launch missiles will get through if it ever is sent, both the USA and the USSR have built a number of alternative submarine communication systems.

The other problem with submarine-launched missiles is that of accurately aiming the missile. Before the missile can be fired at a target, the location of the firing point must be known. In general, the accuracy achieved by the RV at the target can never be better than the uncertainty in determining the launch point, unless some form of in-flight corrections are made. Although such guidance systems are now under development, until now SLBM accuracy has been basically limited by the accuracy and reliability of the navigation equipment aboard the submarines. Radio navigation aids are also very vulnerable to enemy action. In order to provide reliable communication and accurate navigation without compromising the undetectability of the submarine, the US Navy relies on system redundancy, by which is meant that more

[3] This figure has been raised to 15 per cent in fiscal year 1979 testimony.
[4] The ratio in 1978 was 2 446 to 140 according to a US Congressional Research Service Report [6].

systems are built and operated than are actually required at any one moment. On the one hand, redundancy provides some assurance that no matter how thorough the enemy's attacks are, there will always be at least one communication system and one radio navigation aid ('navaid') working. On the other hand, it also enhances security from the viewpoint of the individual submarine commander. If there are several systems available, all providing more or less the same service, the submarine commander can choose that which involves the least chance of revealing the submarine's presence in whatever operational environment happens to prevail at each moment of time.

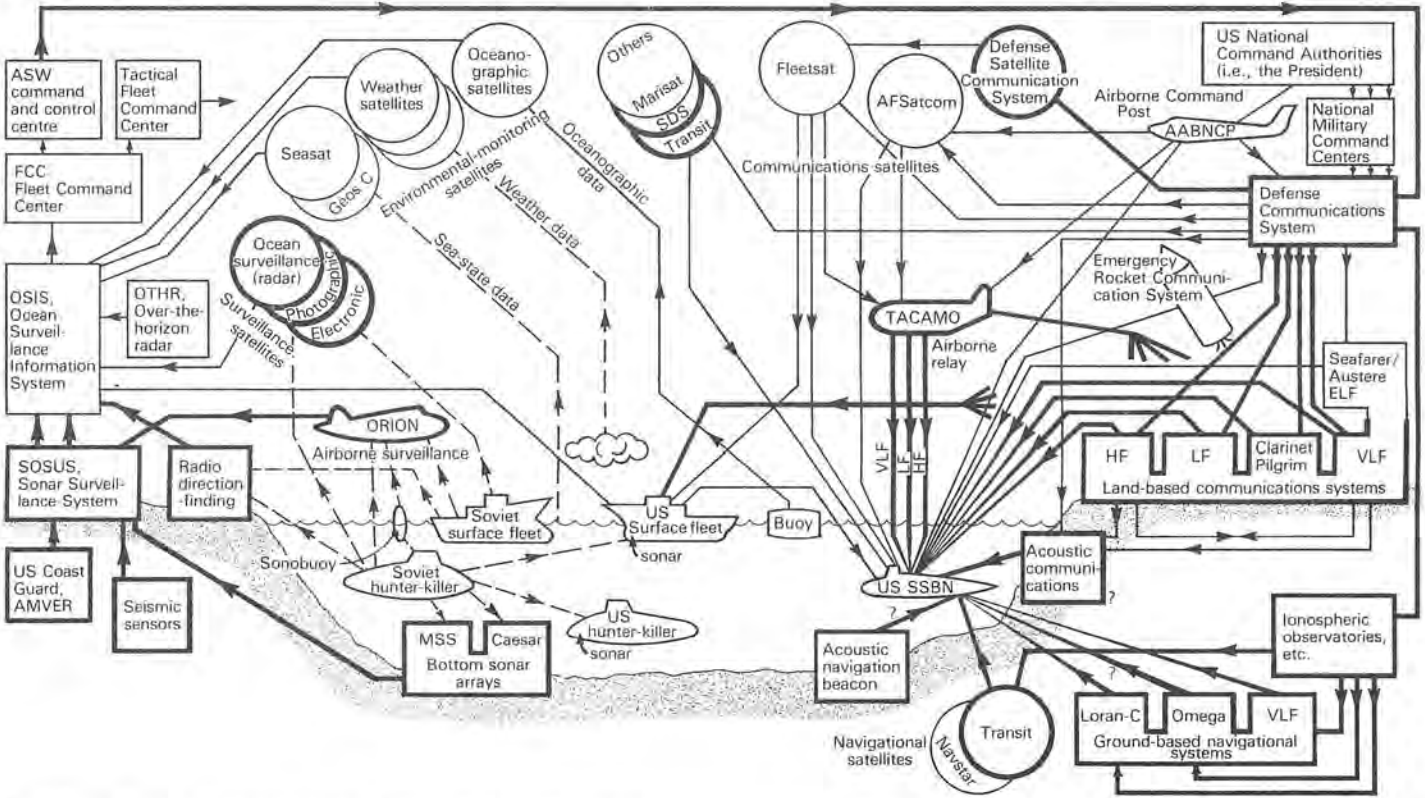
The full range of communication, navigation and surveillance systems which assist in making missile submarines reliable, accurate and invulnerable is shown in figure 7.1. About half of this figure is taken up with the systems linked more closely to ASW and hunter–killer submarines, but since these are involved in protecting missile submarines, they may be considered part of the overall infrastructure supporting the SLBM system. The figure refers specifically to US missile submarines, because more information is available about US systems. Differences in the systems supporting Soviet missile submarines are described below.

Figure 7.1 depicts a stylized ocean with a US SSBN and other US naval forces towards the right, and opposing Soviet ASW forces to the left. Bordering this picture are rectangles symbolizing the various land-based systems, circles symbolizing the various satellites, and pictorial depictions of airborne systems. The radio, optical and acoustic links shown are all based on official or authoritative references, except the queried links which are only presumed to exist.

Explanation of the figure might logically begin at the top right corner. If the US decides to use its SLBMs, the order to do so will originate, in theory at least, with the National Command Authorities—that is, the President of the United States, or if he is incapacitated, the Secretary of Defense or his legal successors.

The order will be expanded into a list of which targets are to be hit by the National Military Command Center, or, if that is destroyed, by Alternate National Military Command Centers or, if they are destroyed, by an Airborne Command Post aboard a Boeing 747 aircraft, one of which is airborne at all times. Then the message will be relayed by a vast network of communication modes to the communication systems that are actually in contact with the submarines. This Defense Communications System has its thousands of channels allotted on a priority basis, with the highest priority going to MEECN, the Minimum Essential Emergency Communications Network, which employs the most survivable communication channels as a duct for

Figure 7.1. Electronic systems involved in support of Polaris, Poseidon and Trident missile submarines



Note: Systems and links shown with heavy lines are those which currently require co-operation of other countries.

messages which will 'implement SIOP', SIOP being the 'Single Integrated Operational Plan' or the total list of strategic and tactical nuclear targets. Less critical operational messages to the submarines are relayed via WWMCCS, the Worldwide Military Command and Control System (pronounced 'Wimmex').

The submarine communication systems are divisible into land-based, airborne, and satellite-borne. The main land-based systems are the giant VLF (Very Low Frequency) transmitters scattered around the world, which provide global communication coverage to depths of 10–15 m (only VLF and lower frequencies have the ability to penetrate seawater to significant depths). The SSBNs are all equipped with two kinds of VLF-receiving antenna which allow for totally submerged reception. One consists of a crossed loop antenna embedded in a plastic buoy which can be unreeled from maximum operational depth by a slow-moving submarine; the other is a trailing long-wire antenna 510 m long which can be towed at up to 30 knots by a submarine at moderate depth [8].

The VLF transmitting antennas are gigantic and relatively fragile. They are also very expensive, so the USA cannot afford to build very many of them. Rather than proliferate VLF antennas all round the world, further redundancy in land-based communications is provided by equipping Loran-C navigation transmitters with a communication system called Clarinet Pilgrim, and by building other low frequency transmitters purely for submarine communications. These are receivable with submarine antennas as much as 3 m below the surface. If all these should fail, the high-frequency fleet broadcast put out by dozens of Naval Communication Stations can be used. Operational messages are also being transmitted at extremely low frequencies (ELF), receivable at 100 m depth. The United States Navy has furthermore developed undersea acoustic communication systems which can operate over ocean distances of several thousand kilometres.

Many of the land-based systems are also received by surface ships which routinely re-transmit at HF and VHF for possible submarine reception. More importantly, the land-based systems are re-transmitted by an airborne relay system called Tacamo, which is regarded as the only nuclear-survivable link.

Then there are the satellites. The Defense Satellite Communication System (DSCS) is essentially part of the Defense Communications System, relaying large volumes of message traffic between major communication nodes and using large complex ground terminals. It probably does not link directly with the submarines.

The AFSatcom system consists of special receiver/transmitter units mounted 'piggyback' on board a variety of military satellites. Its role is specifically to serve as a back-up communication system for US strategic forces. AFSatcom units will in particular be carried by a military satellite series called Satellite Data System (SDS), which has a special type of orbit giving optimal coverage over Arctic areas.

The Fleetsat satellites are intended for general-purpose communications with ships at sea, including submarines. While Fleetsat is under development, the US Navy is renting channels from the 'civilian' satellite Marisat, which the Navy calls Gapfiller.

The submarines carry small retractable mast-mounted antennas for receiving these satellites. Since reception involves surfacing an antenna, the satellites are presumably used only in unusual circumstances. The US Navy's Transit navigational satellites have a communication capability normally used for transmitting the satellite ephemera needed for navigational calculations. This is also available as a back-up strategic communication mode. The ultimate back-up to all these back-ups is the Emergency Rocket Communications System, consisting of several Minuteman missiles in selected silos which carry radio transmitters instead of warheads.

On the left side of figure 7.1 are the surveillance systems which attempt to locate all the Soviet ASW forces which are the principal threat to the US SSBNs. Within the ocean, detection is chiefly performed by sonar, sonar sensors being found on surface vessels, hunter–killer submarines and missile submarines, and are air-dropped as sonobuoys. More important for long-range detection are arrays of sonars laid out on the sea-bed, moored or towed in the ocean by special ships. All these sensors report back, via 'dedicated' communication links or via Fleetsat, DCS and so on to a network of regional analysis centres called SOSUS (Sound Surveillance System) which in turn report back to OSIS, the Ocean Surveillance Information System.

One of the biggest problems of sonar detection is that the ocean is a very noisy place, and it is becoming noisier as more ships ply the oceans and as offshore oil exploitation and other human activities increase. The sonar returns must be cross-checked with the output of other surveillance systems which are gathering information about human activity on the oceans. These include over-the-horizon radar, radio direction finders, and probably the US Coast Guard's AMVER system in which merchant vessels report their positions to aid search and rescue operations. This helps to identify some of the non-threatening noise sources.

The other problem with sonar detection is that sound propagation in the ocean is highly variable and unpredictable, so that distances of and directions to noise sources are difficult to determine. Sound propagation is affected by salinity, temperature, biological factors, and currents, and in order to calibrate the sonar sensors the US Navy needs continuously updated oceanographic information, gathered by the surface navy, oceanographic vessels, marine reconnaissance aircraft, unmanned data-collecting buoys, and to some extent, satellites. Oceanographic measurements are vital to the submarines in a more direct way too. 'Underwater weather' reports allow a submarine to hide itself in whichever ocean layer or area is least conducive to sonar detection. Weather satellites are useful in this respect, and even more important are Geos C and its successor Seasat, which carry radar altimeters sensitive enough to measure wave height and hence sea state, so that submarines can seek out the roughest parts of the ocean where crashing waves will mask the noise of submarine engines, screws, and turbulence. All this information is processed by OSIS and then re-distributed to the users. OSIS interfaces with the Defence Communications System so that relevant information can be relayed back to ASW Command and Control Centers and to the missile submarines.

This leaves navigation. The heart of the submarine navigation system is SINS, the Ships Inertial Navigation System. An inertial navigation aid consists of a collection of accelerometers which measure changes in the velocity of the vehicle (submarine, etc.) and which are linked to electronic circuitry which integrates these data to yield distance travelled and resulting location of the vehicle. The accelerometers are maintained at a constant orientation by a set of gyroscopes, and friction in these gyroscopes results in the determined positions gradually drifting further and further from the true positions, so that in normal use an inertial instrument must be updated periodically from external sources, such as a celestial fix, or more commonly, one of a wide range of navaids.

The accuracy of inertial navigation is limited by the accuracy with which the Earth's shape and size are known, and by knowledge of such variables as the difference between true vertical (a line passing through the centre of the Earth) and apparent vertical (as represented by a plumb-bob). Moreover, the accuracy of the SLBM guidance system is similarly based on inertial measurements and is similarly limited by the accuracy of the same factors—the real distances between the precisely determined positions and the precisely determined launch positions must be known. This may seem absurdly obvious, but before the advent of the missile age, the measured widths of oceans and distances between continents were often in error by several kilometres. Moreover, the trajectory of a missile is affected by the variations in the strength of the gravitational attraction along its trajectory. All these parameters are measured in the science of geodesy. Not shown in figure 7.1, but vital to the accuracy of the SLBM, are the succession of geodetic satellites and the world-wide networks of associated ground stations that have been used by the US military to measure these parameters. Transit, with its associated network of Tranet ground stations, provided most of the geodetic information for the SLBM.

SINS, as already noted, needs to be periodically updated by external sources of navigational information. These are shown in the bottom right corner of figure 7.1. In some cases these navaids utilize the same transmitters as the communication systems already described. Transit navigation satellites are generally assumed to be the main means of updating submarine SINS, by reason of the high potential accuracy of this system. Transit is also available world-wide, although it does have disadvantages. Firstly, it requires surfacing a whip antenna for at least 7 minutes to take a fix, and for 13 minutes to get a fix of maximum accuracy. The safety of such lengthy exposure is dubious to say the least —a whip antenna is potentially quite visible to airborne side-looking radar as carried by marine reconnaissance aircraft. Moreover, Transit is only available when a satellite happens to pass overhead, generally at intervals of about 1½ hours, but sometimes at longer intervals owing to uncontrollable 'bunching' of the satellites. If enemy forces are nearby during a satellite pass, it may be too risky to put up an antenna. Transit is also vulnerable to destruction by anti-satellite weapons, and could easily be spoofed or jammed.

The transmissions of the VLF communications systems were quite early on phase-stabilized so that they could be used for SSBN position-fixing by comparing the arrival times of signals from different stations. VLF navaids have the great advantage of being receivable with totally submerged antennas, but are of relatively low accuracy. More recently, the US Navy has built an eight-station global network of VLF navigation transmitters called Omega, but this appears to be more important for ASW forces than for the SSBNs, and use of VLF navaids by US SSBNs now appears to be insignificant. However, if continuously received, Omega can still increase the overall accuracy of submarine navigation by helping to damp out short-term oscillations in SINS between more accurate fixes obtained from other sources.

Moving up the frequency spectrum a little, there is Loran-C receivable by antennas just beneath the sea surface, with accuracy comparable to or better than Transit, and continuously available over most of the SSBN patrol areas. Loran-C is probably the most important source of navigational information for the SSBNs.

Acoustic navigation is also possible and is becoming increasingly important for the missile submarines.

The radio navaids are all affected in various ways by the vagaries of the Earth's atmosphere and ionosphere. The ionosphere in turn is affected by variations in the radiation output of the Sun. To allow calibration of the navaids, there is a world-wide network of solar observatories and ionospheric sounding stations which, together with a US Navy satellite called Solrad-hi, measure the solar radiation flux before it reaches the Earth. Some of this calibration information is used at the navaid emitter itself—for example, to calculate solar-induced variation in the Transit orbits. In other cases the information must be relayed via the communication systems to the navaid users. The ionospheric information is also used in the day-to-day, if not minute-to-minute, operation of the communication systems, for example, to choose transmitting frequencies most suited to the prevailing conditions. Measurements of atmospheric humidity, made by DMSP weather satellites, may allow more precise determination of Loran-C propagation velocities.

The development of the various navigation systems required even more comprehensive and widespread monitoring than does current operation. Many years of monitoring of LF propagation were necessary, for example, before Loran-C reached its present level of accuracy and reliability. Determination of the factors affecting Transit orbits required many years of monitoring by Tranet stations. These developmental networks and systems are not shown in figure 7.1.

Other electronic and optional systems also contribute to the overall SLBM system. Photographic surveillance and other satellites are involved in the target selection process that results in the SIOP. There are many minor contributors—for example, Project Magnet, and a specially equipped US Navy aircraft which carries out surveys of the long-term variations in the Earth's magnetic field. This information is vital for identifying the geomagnetic 'noise' in Magnetic Airborne Detection (MAD) systems used by ASW aircraft.

IV. The US quest for an invulnerable communications system

The communications links between missile submarines and National Command Authorities were recognized as the Achilles' heel of the entire SLBM system almost from the start of the Polaris programme. The US Navy began investigating the use of extremely low frequency (ELF, of the order of 300 Hz to 3 kHz) waves as early as 1958 in this connection [9]. ELF was seen as particularly suitable because it was potentially receivable world-wide at considerable depths in the ocean, and was relatively invulnerable to jamming, nuclear explosion effects, and natural interference. By the 1960s the US Navy had decided on an ELF system called Sanguine, which was to consist of an antenna array of buried cables covering an area of about 17 000 km^2, together with about 100 deeply buried transmitters. Such a transmitter complex was in the 1960s regarded as virtually invulnerable to nuclear attack. In 1968, for example, the Soviet Union would have had to target about one-third of its strategic nuclear weapons on Sanguine in order to destroy it.

The Navy plans led to the voicing of strong environmentalist objections. In response to the environmentalist criticism and to Congressional concern about the enormous cost ($1.6 thousand million in 1970), the Sanguine proposal was replaced with the rather less ambitious Seafarer proposal which would involve only 8 000 km^2 of antenna and about six less-hardened transmitters. It would consume up to 16 MW of electricity and radiate about 500 W. This concession to the critics was not enough. Operation of a test transmitter in Wisconsin proved that many of the environmentalist objections were unfounded, but still left some doubts [10]. Meanwhile the people living in the proposed antenna location had become aware of the likelihood that a destroyable Seafarer antenna would indeed be destroyed in war, and that they would be destroyed with it.

The US Navy has now cut its plans back even further and it is proposing what it has chosen to call 'Austere ELF', which will consist of a mere 200 km of buried antenna cable, with a power input of a mere 1 MW and a radiated output of only 8 W [11]. This facility, it is proposed, will be operated in Michigan, together with the existing experimental facility in Wisconsin. President Carter was reported to have approved Austere ELF in January 1979.

Seafarer would have covered all significant Trident patrol areas except for the area south of the Philippines, which is probably too congested with surface shipping to be used much anyway. The Austere ELF coverage is much more restricted, with parts of patrol areas in the eastern Mediterranean and the western Pacific not covered. This may mean that the increased range of the Trident missiles will be utilized largely to enable the submarines to patrol closer to the USA where they can enjoy more ASW protection. Alternatively, once the Austere ELF system is built, the US Navy may start lobbying to have it extended to the full Seafarer system.

Seafarer, by virtue of the high natural noise level at ELF and the very narrow bandwidth, would have had an extremely low data transmission rate—perhaps only 10 bits per minute. Austere ELF will be even slower —a three-letter group might take 15 minutes to transmit. However, by appropriate use of highly compressed codes analogous to flag signals, the US Navy claims that it can transmit up to 17 500 different messages using only three-letter groups, and that this is adequate for the purpose for which Austere ELF is intended.

The depth to which Austere ELF will be receivable has not been revealed. However, a programme intended "to determine the feasibility of using a SQUID magnetometer as a submarine-towed receiving antenna for the Navy's ELF strategic communications systems" showed reception of signals from the Wisconsin Test Facility at the "operationally useful depth of about 100 m" [12]. If the full Austere system is built, this depth may be improved upon considerably. SQUID-type antennas may be usable as deep as 400 m.

In assessing the strategic significance of ELF communications, it is important to emphasize that Seafarer was not regarded as capable of surviving nuclear attack. Austere ELF will be even less survivable. Seafarer was officially described as "a relatively soft, surface deployed, extremely low frequency system that can be used in the pre-attack time period; or, if the Continental United States is a sanctuary, in limited strategic nuclear war" [13].

Survivability of SSBN communications is stated to lie rather "in the very redundancy of our ELF/VLF/HF and UHF systems in our fixed sites throughout the world, with the capabilities for communications in every ship or aircraft . . . and with the capability inherent in our mobile and airborne TACAMO system". Seafarer, according to the US Navy, was "not planned to be the vehicle [i.e., system] which must survive to transmit a message for retaliatory attack . . . Seafarer comes into its own in a most important and significant way in any war situation up to that massive exchange which would guarantee its destruction" [14].

It is envisaged that Austere ELF, by allowing SSNs and SSBNs to receive messages while maintaining operational depths and speeds, will guarantee the security of US submarines during conventional war. Present reliance on VLF requires that submarines periodically float up an antenna, an operation which increases vulnerability in many ways—either submarine speed must be reduced, or the submarine must rise above operational depth (depending on what type of antenna is used). The antenna itself emits acoustic energy by strumming, and constitutes a sonar target by virtue of being above protective thermal layers. In clear water a VLF antenna at maximum reception depth may be visible from the air.

Thus, although Seafarer/Austere itself is not survivable, it does enhance overall system survivability in situations short of all-out nuclear war. The advantage in this seems rather insignificant if SSBNs are restricted to a second-strike role but becomes rather more important in a first-strike role. Austere ELF in such a case would help to maintain complete surprise and a high degree of coordination by allowing SSBNs to remain at usual operational depths and yet receive at any time a message to initiate an attack instantly rather than wait for a scheduled

VLF contact. This role was described by Vice-Admiral R. Y. Kauffman, Director of the Strategic Submarine Command and Control Office, in 1973, when he told the Senate Armed Services Committee: " . . . were you to consider the Trident or any submarine in the role of retaliation only . . . you could accept (deleted) delay. On the other hand, were you to demand from the system response to a time-sensitive target, a defense system for example, you would expect response in a matter of (deleted) . . . " [15].

Kauffman was referring to Sanguine, then regarded as survivable. The same arguments apply even more strongly to Austere.

Although the go-ahead for Austere has not been confirmed, the present Wisconsin Test Facility already constitutes an operational system. Signals have been received by operational submarines since late 1972. In 1976 a submarine travelling at 16 knots, 130 m deep, under 10 m of Arctic sea-ice received signals from Wisconsin. Although the Test Facility emits only a tiny 2 W of radio energy, it is receivable over a substantial proportion of the Atlantic and the Pacific, and over all the Arctic Ocean. It is broadcasting operational traffic. By early 1977, five SSBNs and one SSN had been fitted with prototype receivers [16].

Alternative survivable strategic communication systems

A number of other communication modes have been investigated as potential SSBN communication systems. So far it seems that none of these have been implemented, but not all have been rejected, and eventually a feasible survivable system may be found among them.

One proposal was to provide ELF communication by modulating an already existing 1 200-km high-voltage power-line running north–south through the states of Washington and California. This was known as Project Pisces. The proposal had the advantage of requiring no outlay on antenna construction but would have reduced the power load of the line and created environmental problems similar to those of the Michigan antenna, and in a more densely settled area. Pisces would be even less survivable than Austere ELF, and have less 'growth potential', less availability and less global coverage.

There has been a long series of investigations of the possibility of broadcasting strategic communications at VLF or even ULF (ultra-low frequency, that is, even lower than ELF) from satellites. In the mid-1960s it was discovered that the magnetosphere (the region lying outside the Earth's ionosphere) not only propagated VLF, ELF and ULF signals very efficiently, but sometimes it would deliver a stronger signal than had been injected into it. The magnetosphere itself was acting as a gigantic natural amplifier by virtue of a 'geocyclotron' interaction between the radio waves and the spiralling high energy particles in the Earth's radiation belts. Numerous experiments tested the possibility that a geosynchronous satellite could radiate a feeble VLF or ULF signal which would undergo natural amplification. This project was known as Magic Mode. According to a US Navy research report:

A communications system employing this frequency band could not be conceived as a direct competitor to the SANGUINE ELF communications system but might represent a valuable supplement to the latter system under two circumstances. First, if future submerged-warfare technology requires communications from shore based transmitters to receiving stations at several hundred meters depth, the ULF band will have an advantage of about 70 decibels relative to the proposed ELF system in attenuation due to sea water. Second, under the conditions of geophysical variability which follows large solar eruptions and high altitude nuclear explosions communications via ELF may be significantly disturbed. Under these conditions a ULF system may be capable of restoring partial communications. [17]

So far this work has not borne fruit, and in early 1977 Senate testimony, satellite-borne VLF-ULF was still regarded as speculative and high-risk [18].

Optical communications to submerged submarines by means of satellite-borne lasers are another possibility. Blue–green lasers of about 0.5 micrometre wavelength will propagate through seawater to considerably greater depths than will VLF radio waves. At present this work has reached the stage of letting research contracts, but the use of lasers is held to be costly and inefficient. Presumably the satellites would have to be in Transit-type orbits or lower, thus having the disadvantage of only intermittent communication when a satellite happened to be near the zenith.

Perhaps the ultimate proposal for deep submergence communications is that of using neutrino beams. The neutrino is a sub-atomic particle, having no electrical charge and apparently no mass, which is capable on average of passing through all the matter in the universe, so that reaching the utmost depths of the ocean is simply not a problem. It has been proposed that a neutron accelerator in the USA could be steered so as to shoot modulated bursts of neutrinos right through the Earth to submarines anywhere in the ocean. Reception would be accomplished by optical or acoustic detection of the particle showers occurring within the ocean every time a neutrino collided with a nucleus of a seawater constituent (one collision for every 17 tonnes of matter penetrated). Experiments by the US Naval Research Laboratory have shown that a 15-bit message can be transmitted during an 8-second burst cycle [19]; propagation experiments are now under way at the University of Washington.

Several acoustic communications systems have been proposed. In general the range of acoustic communications is limited, signal propagation velocity is very low, the acoustic transmitters can be destroyed and resistance to jamming is low. It has been proposed that the last two objections would be nullified if seismic methods were used as "a means of generating acoustic waves for reception by submarines". These schemes are also considered "exotic and technically not promising" [20].

The Tacamo communication system

Tacamo consists of 13 specially modified C-130 transport aircraft allocated to two squadrons. Each squadron is responsible for ensuring that at least one plane is airborne at all times over both the Pacific and Atlantic Oceans. Other aircraft are on a 15-minute alert. The aircraft act as communication relay links in the MEECN between National Command Authorities and the submarines. Several redundant communication up-links are used and the aircraft themselves transmit at VLF, LF, HF, and UHF.

Each aircraft carries a 200-kW VLF transmitter coupled to a 10-km long wire antenna which is trailed behind the aircraft. With the aircraft flying in a continuous tight turn, the antenna hangs vertically and constitutes a relatively efficient VLF radiator. In peace-time the aircraft fly 10½-hour missions which begin and end at different airfields around each ocean in a random pattern so that their positions are generally unknown to an enemy. In wartime the aircraft can be instructed to pay out its antenna and begin transmitting. One aircraft over each ocean can provide communications to all US missile submarines, except possibly those in the eastern Mediterranean.

Tacamo is now regarded as the principal mode of communication with the submarines, and is the only mode regarded as capable of surviving a nuclear war. Over 1 000 personnel are assigned to operating the Tacamo system. The expanded patrol area of Trident will require the Tacamo operation to become even bigger [21].

As the only survivable SSBN communication system, Tacamo must be regarded as crucial to the successful maintenance of second-strike SSBN capability. However, the survivability of even Tacamo must be somewhat doubtful—in particular, it seems likely that satellite-borne radar must soon become capable of detecting an airborne target with a radar cross-section as big as that of a C-130.

V. Soviet strategic communications systems for missile submarines

In general, there is little information published about the communications systems used to communicate between Soviet National Command Authorities and the Soviet missile submarine fleet. What little information there is might best be examined by presuming the existence of an overall systems architecture like that shown in figure 7.1 for US systems, and then placing the available information into that framework.

The Soviet Union has a military communications system incorporating a degree of redundancy similar to that of the USA. This includes alternative national command posts and airborne command posts. Links in the network are provided by various land-line, 'Molniya' satellite, troposcatter and microwave systems. The Molniya system is used in particular for bulk transfer of large volumes of communications traffic over point-to-point circuits within the Soviet Union. There are, for example, 'Orbita' terminals for the Molniya satellites at Moscow, Vladivostok, Murmansk and Kamchatka which might be used to distribute messages intended ultimately for the missile submarines.

Very low frequency radio is undoubtedly the principal mode for communicating with the missile submarines. There are 10 Soviet VLF stations with listed outputs greater than 100 kW. Five of these are of 500 kW power or greater and coverage of each of these five is described as world-wide in the data supplied to the International Telecommunications Union by the Soviet Union [22]. There are a further 16 smaller stations. The USA, for comparison, has seven major stations, and two more are operated by NATO, all for submarine communications (there is no evidence to confirm that the Soviet stations are used solely for submarine communications). Soviet transmitters provide heavily redundant coverage of the Arctic and lesser concentrations on the Black Sea and Pacific coasts. By contrast, the smaller number of US stations are distributed more evenly around the globe.

A systematic search through the VLF band carried out in New Zealand showed that received signal strength in that part of the world of US and Soviet stations is roughly equivalent [23].

Soviet VLF transmitters tend to be concentrated in the lower part of the VLF band, indicating perhaps an emphasis on maximizing seawater reception depth rather than data rate.

There is no information available on other land-based systems, but presumably the Soviet Union makes heavy use of high frequency (HF) radio as a back-up to VLF. There is no evidence for any 'survivable' communications relay analogous to the US Tacamo, but surface vessels undoubtedly have a HF relay capability.

The Soviet Union has a well-developed communications system using Molniya satellites in high elliptical 63° inclination orbits, 'Statsionar' satellites in geosynchronous orbits, and Orbita ground stations.

However, this system seems to be primarily non-military in character. The Molniya satellites make two orbits every 24 hours, such that alternate orbits 'linger' over the Soviet Union and over the United States for periods of about 9 hours. It is conceivable that while over the USA a Molniya satellite might provide communications to submarines in the north-western Atlantic and northern Pacific, although there is no published evidence that this happens. However, it is known that Soviet space-tracking ships use Molniya for data relay from the Indian Ocean, and at least one Arctic ice-breaker is also equipped to use Molniya [24].

The Soviet Union also launches considerable numbers of what are usually believed to be communications satellites operating in 1 500-km orbits and launched eight at a time. These satellites are believed to operate in a 'store–dump' mode and, although no emissions from them appear to have been recorded in the West, it is possible that they could serve as communications relays to submarines. The principal disadvantages of such a system would be the appreciable time lapse between injection of a message into a satellite and its relay to the submarine, the necessity for the submarine to surface an antenna, and the vulnerability of the medium-altitude satellites to electronic and physical countermeasures.

A new class of Soviet geostationary multi-purpose communications satellite, called Volna, is scheduled for implementation in 1980. These satellites will operate in bands allocated for maritime services similar to those used by the US naval communications satellites. The satellites will be receivable with shipboard antennas about one metre in diameter [25]. The satellites will be located over the Atlantic, Indian and Pacific Oceans, and have obvious potential for real-time communications relay to missile submarines.

There is some evidence that the Soviet Union has at least considered the use of ELF and ULF communications modes. The Soviet Union has carried out an ambitious programme of research in propagation at these frequencies—possibly the largest such programme in the world. Much of it has centred around the so-called Omega project consisting of conjugate point studies carried out in conjunction with France, in which ULF propagation modes were studied between points in Siberia and conjugate points in the southern Indian Ocean. A US DARPA review of this research concluded by noting

> that although no Soviet researcher professes an interest in using micropulsation modes [i.e., ULF] for strategic communication purposes there are two facts which remain. First the advantage of such a system is abundantly clear. Second if modes appropriate to communication modes exist, Soviet scientists, because of the magnitude of their efforts and their depth of understanding of this discipline, have an excellent chance of being both their discoverer and exploiter. [26]

In summary, it can be said that the Soviet Union is probably heavily reliant on VLF for strategic communications, with a back-up capability provided by HF, and possibly by satellites. The new Volna satellite series will probably be used by the missile submarines. Although the Soviet Union appears to have investigated ULF modes there is no evidence of any attempt to exploit them.

If only land-based VLF is looked at, the USSR appears to have more redundancy than the USA. However, this advantage is nullified if the thirteen 100-kW transmitters of the US Tacamo system are taken into account. If the land-based Soviet VLF transmitters were destroyed, the Soviet Union might be left with only HF back-up, with all the hazards that such dependency implies—in particular the vulnerability of HF to natural or nuclear disturbance of the ionosphere, and the necessity for submarines to surface an antenna of substantial dimensions.

In conclusion, it seems that restricted variety of communication modes available to the Soviet missile submarine fleet is an important factor in degrading overall system security compared with US missile submarines. The seeming simplicity of a US damage-limiting strike against missile submarine communication facilities raises serious doubts about the survivability of this component of Soviet deterrent forces.

VI. Potential accuracy of US SLBM missiles

Unless some form of in-flight guidance is used, the terminal accuracy of a submarine-launched missile cannot be better than the navigational uncertainty of the launching submarine. Hence, by describing the navigational error budget, it is possible to establish the best possible accuracy for the missile.

The Polaris missile, primarily intended for an anti-city role, needed to be accurate only within two or three kilometres.[5] Submarine inertial systems available for Polaris submarines had drift rates of 1.5 to 3 km per day, and hence needed to be updated several times a day by external sources, such as Loran-C, then capable of 100 m accuracy, and Transit, then accurate to within 200 m.

Upgrading of existing navaids and introduction of new navaids gradually took place as successive Polaris versions and later the Poseidon were introduced. These navaid improvements contributed to both increased system security (by increasing the interval between navigation fixes) and increased system accuracy. Poseidon was initially intended to have a significant counterforce hard-target role, to be

[5] All accuracy figures refer to CEP (circular error probability), that is, the radius of the circle within which 50 per cent of the missiles will hit.

attained in part by use of mid-course guidance. This was to incorporate optical star tracking (stellar-inertial guidance, or SIG) aboard the missile to provide mid-course corrections of heading errors resulting from the inadequate azimuth accuracy of the submarine navigation equipment. Development of this system was reportedly abandoned in 1970, in response to Congressional reluctance to approve anything that smacked of hard-target capability.

Nevertheless, Poseidon was intended to implement the doctrine of 'flexible response' which implied a capability of hitting more than just urban and industrial centres, without going all the way to a full first-strike capability. Poseidon is usually credited with a CEP of about 500 m, which is assumed to be gradually improving. Poseidon is supposed to have a 10 per cent kill probability against 1 000 p.s.i. targets, as compared with 20 per cent for Minuteman III [27]. A director of the US Navy's Strategic Submarine Division has testified with regard to Poseidon: "The efficiency of killing a hard target is low, but we do have the ability to kill a hard target" [28].

The improved accuracy of Poseidon (and its resulting hard-target capability, and improved survivability of the Poseidon system) came about in part through improvements in the Transit and Loran-C systems. Improved accuracy in Loran-C was achieved by means of the phase shift system. Loran transmitter synchronization was raised to a ±200 nanosecond tolerance, and synchronization adjustments began to be made by means of very small shifts in signal phase. The new level of inter-station synchronization allowed navigation by the range–range mode as well as the hyperbolic mode, which had the effect of increasing the patrol area in which Loran-C was usable. A new receiver, the AN/BRN-5, was designed to take advantage of the increased transmitter stability [29].

The Transit system has undergone a variety of gradual improvements. In particular, improved geodetic control allowed Transit orbits to be more closely predicted. New computation techniques eliminated the errors formerly caused by inadequate knowledge of submarine velocity.

As a result of the various improvements, Loran-C became capable, at least in some situations, of having a repeatable accuracy as good as 15 m [30], while Transit began to yield single-passage accuracies of 18 to 36 m for stationary land-based instruments. Normal ship-board fixes for both systems were better than 100 m. Loran-C appears to be the principal source of navigational information for Poseidon, by reason of its marginally greater accuracy, continuous availability, enlarged coverage area, increased signal strength, and greater resistance to countermeasures.

The Trident I missile will have the same accuracy at its extended range as Poseidon has at half the range. This will be achieved by use of SIG like that originally developed for Poseidon which will essentially eliminate cross-track errors due to inadequate azimuth information at the launch point. The Mark 5 Trident SIG underwent its first successful flight test in January 1977.

Launch position errors will be reduced and time intervals between external fixes extended, by adding electrostatically supported gyro monitors (ESGMs) to the submarine inertial navigators. The essence of ESGM is a gyroscopic rotor supported by an electrostatic field inside an evacuated sphere. Such a rotor is almost frictionless, and can be spun up to operating speed before a vessel leaves port and then be allowed to coast for several weeks, free of all disturbing influences except those it is designed to measure. A submarine so equipped may operate for several weeks without the necessity to take any external fixes at all.

Errors in knowledge of local gravity field enter the missile guidance system by virtue of the fact that an inertial unit reacts identically to both inertial and gravitational accelerations. Several weeks are spent in surveying the gravity field around, for example, a Minuteman silo so that the gravitational acceleration can be allowed for. Obviously the same survey cannot be carried out round a submarine's instantaneous launch point. Satellites can measure the grosser variations in the field but not the fine structure, which induces Schuler oscillations in the submarine inertial unit [31]. These oscillations lead in particular to velocity errors. Missile trajectories are highly sensitive to down-range velocity errors and this sensitivity increases dramatically with increasing missile range. It is this factor that now blocks achievement of the 'ultimate' zero-error inertial unit. The solution to this problem being worked on at present is a submarine-borne gravity gradiometer, which will measure the rate of variation in the gravitational acceleration. A gradiometer together with frictionless gyro rotors makes zero-error navigation possible within the limits of relativistic and geophysical effects, such as wandering of the Earth's poles.

In so far as such a near-perfect inertial navigator needs external updates at all, these will be available from, among other sources, the Navstar Global Positioning System. Navstar will provide fixes to better than within 7 metres horizontally and to within 10 metres vertically. The current trial system has actually achieved errors as small as 1.5 metres in latitude. Navstar will be usable anywhere on the globe at any time, and it will be highly invulnerable to countermeasures. Hydrogen maser clocks are under development for the satellites which are so stable that even after the ground stations are destroyed the satellites will continue to broadcast accurate signals for several weeks. At $8 million to $9 million each, it costs less to replace satellites in orbit than it costs an enemy to shoot them down. Navstar will, like Transit, require a submarine to surface an antenna, but for a much shorter period of time, and at a time of the submarine's own choosing. Navstar has not yet received a final go-ahead, and the US Navy has not yet committed itself to using it for SLBMs. However, trials so far have been very successful, a submarine receiver is under development, and initial operational capability is expected in 1985.

Navigation by means of underwater sound waves appears to be assuming greater importance with the advent of Trident. Navigation sonar is apparently no noisier than submarine propulsion and hence does not increase the submarine's liability to detection. Three different types are under development—active sonar recognition of underwater topographic features, interrogation of previously implanted sonar beacons, and improved parametric Doppler sonar (operating to depths of 6 000 metres beneath the keel) for measuring velocity relative to the sea-bed.

Whatever doubts there may be about Trident I having hard-target potential, the options are wide open for Trident II to have a very definite hard-target capability. Trident II will have the option of being fitted with AMaRV, or Advanced Maneuverable Reentry Vehicles, which will have target sensors to provide terminal steering commands so that the warhead will home on to its targets with errors of less than 100 metres [32]. AMaRV is a product of the ABRES (Advanced Ballistic Reentry Studies) programme. According to a US Director of Defense Research and Engineering:

> Maneuvering for accuracy, the Precision Guided RV Program, is one of the major efforts in the ABRES Program. We want to obtain the really high accuracies required for having high confidence in the precise application of force in flexible nuclear options —that is, to have extremely high probabilities of kill and low collateral damage. To do this may require the use of guidance systems whose accuracy is independent of the errors which always arise during missile flight. You are familiar with this approach in tactical war, where precision guided munitions can now be delivered with accuracies of a few feet, thanks to terminal guidance techniques. Conceptually, this same sort of technique will work with missiles. [33]

Terminal guidance techniques under consideration include TERCOM (an altimeter profile matching scheme which has already been flight tested), MICRAD (a microwave radiometer approach), RADAG (a radar range/cross-section correlation technique), and several laser and optical approaches.

To get the RVs to the vicinity of the target, various forms of mid-course guidance will be used, including two-vector SIG and Navstar. Accurate navigation by the submarine will then be of little significance for terminal missile accuracy.

Terminal guidance and the other technologies are being pursued under the Improved Accuracy Program which is intended to satisfy "the potential future needs for increased submarine ballistic missile effectiveness across the entire target spectrum" [34].

VII. Soviet submarine navigation and SLBM accuracy

Information about navigational accuracies attainable by Soviet missile submarines is meagre, but such information as is available suggests that capabilities are considerably less than those of the USA.

The Soviet Union was very slow in its development of inertial navigation units for submarines. Inertial components represent some of the most refined products of Western materials science and engineering technology, and it is not surprising that the Soviet Union has had difficulty in following the Western lead. Certain engineering equipment essential to manufacture of inertials, such as precision grinders, is not allowed to be exported by the Western countries to the Soviet Union. There is no evidence of submarine inertial navigation systems being deployed at all until 1966 by the Soviet Union [35], and in the 10 years since then, there is scant evidence of any degree of dependence on inertial navigators. This has been interpreted in the West as perhaps indicating that SLBMs deployed up to 1966 had an anti-shipping and anti-submarine role rather than a strategic retaliatory role.

A sophisticated system for evaluating and combining position information and inertial information equivalent to the US NAVDAC computer and its successors is probably also unavailable to the Soviet submarine. NAVDAC and similar devices are dependent on a data-processing technique called Kalman filtering, and there is said to be no evidence that the Soviet Union has any type of computer than can perform Kalman filtering [36].

The Soviet Union appears not to have built any land-based navigation aids for the purpose of missile submarine positioning. Until recently this would have been impossible anyway because of the USSR's lack of friendly territory in the vicinity of its SLBM patrol areas, with the exception of Cuba. This seems to be part of a general backwardness in the field of navaids of all types. The civil aviation network of navaids, for example, has been described as "most striking" in its sparsity [37].

A VLF radio navaid, informally called the 'Alpha System' in the West, with remarkable similarities to the US Omega system, has been operating since 1971. It relies on three transmitters, with 500-kW outputs registered in the International Frequency List, but in practice radiating about 100 kW, located in the eastern and western extremities and in the geographic centre of the Soviet Union. This geometry is ideal for navigation within and around the Soviet Union, and could, for example, be used by Delta submarines in the Barents Sea and in the western Pacific. The high power of the transmitters (at least 10 times that of the Omega transmitters) gives potentially world-wide coverage but with accuracy less than that of Omega. The manner in which the frequencies are offset from those of Omega suggests that the system is optimized for aircraft use, and the signal format appears to be optimized for reception by low-cost digital receivers [38]. The evidence for SLBM use is thus not strong but, as in the case of Omega, Alpha signals continuously received by submerged submarines could significantly improve navigation accuracy by damping out short-term inertial oscillations between intermittent external fixes of higher accuracy.

The Soviet Union also operates two Loran-C chains. One, in the vicinity of Vladivostok, was built to serve shipping in the crowded fog-prone approaches to Vladivostok. The other, covering much of the European USSR, appears to be mostly for aeronautical use, although it also would be usable in the Baltic. There is no evidence that Soviet missile submarines use Soviet Loran-C.

It is quite conceivable that Soviet submarines might use US Loran-C chains for launch point determinations. US chains cover most of the 'Yankee'-class patrol areas in the north-western Atlantic and north-eastern Pacific, while the western Pacific and Aleutian chains would be usable by Delta submarines in the Pacific. The northward expansion of the Norwegian Sea chain as proposed by Norway would provide coverage of the Barents Sea Delta patrol area. The US Omega system would similarly be usable world-wide. The Soviet Union must assume that the USA has contingency plans for switching off or scrambling these systems in time of war. They would therefore be of value to the Soviet Union only if a first strike were contemplated.

The principal Soviet SLBM navigation system appears to be a satellite navigation system similar to Transit. The Soviet Union claims to have had navigation satellites since 1966, but the first operational system identified by Western monitoring commenced in 1971. This has now evolved into a system generally consisting of six satellites in orbital planes spaced at 60° intervals around the globe, and a later system with six satellites at 30° intervals. An 83° orbital inclination gives global coverage, and the density of orbits gives virtually continuous and often redundant coverage of all parts of the Earth, something which is not available from Transit. The satellites operate at frequencies similar to those of Transit, and have a somewhat similar signal format, the content of which has been satisfactorily deciphered and explained in the West [39].

The one weakness in the Soviet system appears to be that of accuracy. The Soviet Union lacks an equivalent to the global network of TRANET tracking stations operated by the USA since the advent of Transit for the specific purpose of obtaining geodetic information needed for accurate orbital predictions. This would appear to limit the Soviet system to the sort of accuracy achievable by Transit in the Polaris era.

In summary, the range of navigation aids available to Soviet submarines offers less accuracy and less redundancy than that available to US submarines. There appears to be heavy reliance on a lower-accuracy satellite system, with possible back-up provided by traditional celestial methods and perhaps use of US navaids. Owing to poorer inertial and data-processing equipment, Soviet submarines probably have to take external fixes at much more frequent intervals than US submarines, which must constitute a significant factor in making Soviet submarines vulnerable to US ASW.

One way out of this problem is for the Soviet Union to develop mid-course or terminal guidance. The continuous availability of signals from Soviet navigation satellites may lead to a moderately accurate mid-course guidance system similar to that envisaged for US missiles using Navstar. So far this has not come about, but the Soviet Union is consistently reported in the West as having a stellar-inertial guidance system on the long-range SS-N-8 SLBM. US officials have been quoted as saying that stellar-inertial guidance had "done little to improve the accuracy of the missile" [40]. The SS-N-8 is currently quoted as having an accuracy of 0.8 nautical miles (1.3 km), as compared with the 0.5 km of the US Poseidon. This accuracy is considerably better than the accuracies attributed to the shorter-range SS-N-4/5 and SS-N-6, so in this sense it may be said that stellar-inertial guidance has definitely done a great deal to improve the accuracy of the Soviet SLBM, and the SS-N-8 might be the first step towards the eventual acquisition of hard-target capability for Soviet SLBMs.

It is reported that the SS-N-18, a follow-on to the SS-N-8, will be equipped with a more refined stellar-inertial unit which will take sightings on two stars [41]. One sighting will allow corrections for azimuth, and the other will allow partial correction of launch position error. If this report is substantiated, then the second-generation missile for Delta submarines will have an accuracy considerably better than the present missile, and will probably be comparable with that of the US Trident I.

VIII. Conclusions

The capabilities of submarine-borne strategic missile arsenals constitute an important aspect of any examination of future possibilities for war and peace. An attack by only five US Poseidon submarines could kill 37 million people and destroy 60 per cent of Soviet industry [42]. By the 1980s five out of every six US nuclear re-entry vehicles that could reach the Soviet Union will be carried aboard submarines [43].

This chapter has described some of the ways in which SLBMs are evolving from second-strike deterrent weapons into potential first-strike counterforce weapons. This evolution principally involves changes in the electronic infrastructure (navigation, guidance, communications) of the SLBM system. In the case of the USA, this evolution is well under way with Poseidon and will essentially be complete when Trident II becomes deployed. In the case of the Soviet Union the evolution is much less advanced, but the missiles aboard the Delta submarines now do represent an advance toward counterforce capability.

So far there has not been widespread concern about the potentially destabilizing implications of these changes. The US Arms Control Impact Statement made to the Congress [44] rather blandly notes that Trident II "could be perceived as a first strike weapon with a significant hard target kill potential against time urgent targets", and that "the potential impact of the Trident II missile on strategic stability . . . may be negative due to the significant hard target kill capability". The statement notes further that SLBMs have certain advantages over ICBMs as counterforce weapons and that SLBMs can become as accurate as ICBMs. The risk implicit in the possession of counterforce capability by the USA is dismissed by noting that it is announced US policy to forgo a first-strike doctrine.

Such an announced policy is open to suspicion at the present time. Within the US military leadership there is currently much doubt as to the ability of US command systems to function after a war has begun, and this has caused a general shift away from the doctrine of deterrence towards attempting to solve the problems of actually fighting and winning a nuclear war [45]. This chapter has demonstrated how insecure the command links are to the SLBMs. Even a neutrino communications system would not be nuclear-survivable—the necessary accelerator would be enormous, and difficult to 'harden'. The ELF system currently being advocated is non-survivable, and is justified as enhancing SLBM capabilities against 'time-sensitive' targets. This makes Austere ELF an analogous development to the Command Data Buffer System incorporated into Minuteman launch complexes. Both developments allow rapid re-targeting and enhance US ability to fight and win a nuclear war, rather than merely guarantee a capability for assured destruction.

There are some rather startling asymmetries in the US and Soviet SLBM forces. The difference in total lethality has been recognized for some time, and is widened further in US favour by the Soviet Union's policy of keeping most of its submarines in port (presumably this policy would change in a seriously deteriorating international situation). This chapter has demonstrated, in so far as evidence is available, that Soviet navigation, guidance and command systems are on the whole less redundant and less survivable than those of the USA. Navigation guidance systems for Soviet SLBMs are not yet accurate enough to confer any significant counterforce capability.

One final point is worth noting. Figure 7.1 illustrates that a missile submarine is not simply an isolated entity hidden and invulnerable in the middle of the ocean. There is a large and complex web of all kinds of supporting systems located in the ocean, on land, in the air and in space. As shown in figure 7.1, the USA is currently dependent on the cooperation of many other countries in accommodating these systems. In the absence of meaningful arms limitations by the USA and the USSR, smaller countries might make a modest contribution to arms control, and enhance their own security, by refusing to act as host to SLBM infrastructure systems.

References

1. *The Military Balance 1978–1979* (International Institute for Strategic Studies, London, 1978), pp. 80–81.
2. Pretty, R. T., ed., *Jane's Weapon Systems* (Jane's Yearbooks, London, 1977).
3. *Offensive Missiles,* Stockholm Paper No. 5 (Almqvist & Wiksell, Stockholm, 1974, Stockholm International Peace Research Institute).
4. Aldridge, R. C., 'The counterforce syndrome, a guide to US nuclear weapons and strategic doctrine', Pamphlet series No. 7 (Transnational Institute, Washington, D.C., 1978).
5. Ball, D., 'The counterforce potential of American SLBM systems', *Journal of Peace Research,* Vol. 14, No. 1, 1977, pp. 23–40.
6. *Evaluation of Fiscal Year 1979 Arms Control Impact Statements: Toward more Informed Congressional Participation in National Security Policy-making,* Report prepared for the Subcommittee on International Security and Scientific Affairs of the Committee on International Relations, US House of Representatives, 3 January 1979 (US Government Printing Office, Washington, D.C., 1978), p. 104.
7. Brown, G. S., 'United States military posture for fiscal year 1978', US Joint Chiefs of Staff, 20 January 1977, p. 14.

8. Fessenden, C. T. and Cheng, D. H. S., 'Development of a trailing wire E-field submarine antenna for Extremely Low Frequency (ELF) reception', *I.E.E.E. Transactions on Communications*, Vol. COM-22, No. 4, April 1974, pp. 428–37.
9. Merrill, J., 'Some early historical aspects of project Sanguine', *I.E.E.E. Transactions on Communications*, Vol. COM-22, No. 4, April 1974, pp. 359–63.
10. Carter, L. J., 'Seafarer: project still harmless as Milliken says no to Navy', *Science*, Vol. 167, 2 September 1977, pp. 964–68.
11. Boyle, D., 'ELF—an essential communications system', *International Defense Review*, Vol. 11, No. 7, 1978, pp. 1149–51.
12. Dinger, J. A., Davis, J. R., Goldstein, J. A., Meyers, W. D., Wolf, S. A. and Cates, F., 'Techniques for ocean bottom measurements of magnetic fields with a superconducting magnetometer', *I.E.E.E. Transactions on Geoscience Electronics*, Vol. GE-15, No. 4, October 1977.
13. *Department of Defense Appropriations, Fiscal Year 1977*, Hearings before the Committee of Appropriations, US Senate (US Government Printing Office, Washington, D.C.), Part 4, p. 990.
14. *Hearings on military posture for fiscal year 1978*, House Committee on Armed Services, US Congress (US Government Printing Office, Washington, D.C., 1977), Part 3, Book 2, pp. 1845–79.
15. *Hearings on military procurement for fiscal year 1974*, Senate Armed Services Committee, US Congress (US Government Printing Office, Washington, D.C., 1973), Part 4, p. 2211.
16. *Hearings on military posture for fiscal year 1978*, House Committee on Armed Services, US Congress (US Government Printing Office, Washington, D.C., 1977), Part 3, Book 1, p. 651.
17. Davis, J.R., Willis, J.W. and Althouse, E.L., 'Magic Mode: investigation of artificial stimulation of ULF waves in the ionosphere and magnetosphere', *Naval Research Laboratory Report* 7552, 12 March 1973.
18. *Hearings on military procurement for fiscal year 1978*, Senate Armed Services Committee, US Congress (US Government Printing Office, Washington, D.C., 1977), Part 10, p. 6746.
19. Saenz, A. W., Überall, H., Kelly, F. J., Padgett, D. W. and Seeman, N., 'Telecommunication with neutrino beams', *Science*, Vol. 198, 21 October 1977, pp. 295–97.
20. *Hearings on military procurement for fiscal year 1977*, Senate Armed Services Committee (US Government Printing Office, Washington, D.C., 1977), Part 10, p. 6746.
21. Black, K. M. and Lindstrom, A. G., 'Tacamo', *Signal*, Vol. 33, No. 1, September 1978, pp. 6–13.
22. *International Frequency List*, 9th edition (International Telecommunications Union, Geneva, 1977), Vol. 1, '10–4 063 kHz'.
23. Amon, L. E. S. and Dowden, R. L., 'V.L.F. stations detected at Dunedin', Physics Department, University of Otago, New Zealand, January 1976, mimeographed.

24. 'Icebreaker steered via space', *Spaceflight*, Vol. 20, No. 12, December 1978, p. 421.
25. 'Soviet marine communications satellite network plans detailed', *Aviation Week and Space Technology*, Vol. 107, No. 20, 14 November 1977, p. 20.
26. Beitchman, J. G., *Soviet micropulsations research for possible communications application,* Concord Research Corporation, February 1973, US National Technical Information Service Accession No. AD 759 380.
27. Robinson, C. A., 'New propellant evaluated for Trident second stage', *Aviation Week and Space Technology*, Vol. 103, No. 15, 13 October 1975, pp. 15–19.
28. *Hearings on military posture for fiscal year 1978*, House Committee on Armed Services, US Congress (US Government Printing Office, Washington, D.C., 1977), Part 3, Book 1, p. 612.
29. Dean, W. N. and Roth, D. P., 'The AN/BRN-5 Loran receiver', *Navigation: Journal of the Institute of Navigation*, Vol. 23, No. 4, Winter 1976.
30. 'Loran-C user handbook', US Coast Guard publication No. CG-462 (US Department of Transportation, 1974).
31. Gerber, M. A., 'Gravity gradiometry—something new in inertial navigation', *Astronautics and Aeronautics,* Vol. 16, No. 5, May 1978, p. 18.
32. Aldridge, R. C., 'The counterforce syndrome: a guide to US nuclear weapons and strategic doctrine', TNI Pamphlet series No. 7, (Transnational Institute, Washington, D.C. and Amsterdam, 1978).
33. *Hearings on military posture for fiscal year 1976*, House Committee on Armed Services, US Congress (US Government Printing Office, Washington, D.C., 1975), Part 4, p. 3841.
34. Statement of Hon. H. Tyler Marcy to the US Senate Appropriations Committee, 24 February 1977 (Committee mimeograph).
35. Moore, K. J., Flanagan, M. and Helsen, R. D., 'Developments in submarine systems, 1956–1976', M. MccGwire and J. McDonnell, eds., *Soviet Naval Influence: Domestic and Foreign Dimensions* (Praeger, New York, 1977).
36. 'Perspective: Soviets lag in radar signal processing', *Electronic Warfare/Defense Electronics*, Vol. 10, No. 7, July 1978, p. 85.
37. Cheilek, H. A., Seymour, W. R., Heinze, K. P., Kresse, A. O. and Scheiber, L. B., 'Impact of Navstar global positioning system on military plans for navigation and position fixing systems', *Institute for Defense Analyses Report* R-217, October 1975, US National Technical Information Service Accession No. AD B011 137, p. 63.
38. Burhans, R. W., 'Possible methods for USSR-VLF receivers', Tech. Memorandum (NASA) 22 (Avionics Engineering Center, Ohio University, March 1976).
39. Perry, G. C., 'Soviet navigation satellites', *Royal Air Forces Quarterly* (United Kingdom), Vol. 18, No. 3, Autumn 1978, pp. 276–84.
40. 'Soviets test new MIRV warhead ICBMs', *Aviation Week and Space Technology*, Vol. 100, No. 8, 25 February 1974, p. 20.

41. Ackley, R. T., 'The wartime role of Soviet SSBNs', *US Naval Institute Proceedings*, Vol. 104, No. 6, June 1978, pp. 35–42.
42. Polamar, N. and Paolucci, D. A., 'Sea-based "strategic" weapons for the 1980s and beyond', *US Naval Institute Proceedings*, Vol. 105, No. 5, May 1978, p. 98.
43. Morrison, P. and Walker, P. F., 'A new strategy for military spending', *Scientific American*, Vol. 239, No. 4, October 1978, pp. 48ff.
44. *Fiscal Year 1979 Arms Control Impact Statements*, House Committee on International Relations and Senate Committee on Foreign Relations, US Congress, June 1978.
45. Bradsher, H. S., 'Doubts cast on nuclear deterrence doctrine', *Washington Star*, 1 December 1978.

Appendix 7A

US and Soviet strategic nuclear forces, 1970–79

Figures for 1970–76 are as of 30 June; figures for 1977–79 are as of 30 September.

		First in service	Range (nm)	Payload	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Delivery vehicles														
Strategic bombers														
USA	B-52 C/D/E/F	1956	10 000	27 000 kg	231	198	149	149	116	99	83	83	83	83
	B-52 G/H	1959	10 900	34 000 kg	281	281	281	281	274	270	265	265	265	265
	(FB-111	1970	3 300	17 000 kg	33	66	66	66	66	66	66	66	66	66)
USSR	Mya-4 'Bison'	1955	5 300	9 000 kg	40	40	40	40	40	40	40	40	40	40
	Tu-20 'Bear'	1956	6 800	18 000 kg	100	100	100	100	100	100	100	100	100	100
	(Tu-26 'Backfire'	1975	4 000	9 000 kg	–	–	–	–	–	12	24	36	48	60)
				Long-range bomber total: USA	**512**	**479**	**430**	**430**	**390**	**369**	**348**	**348**	**348**	**348**
				USSR	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**140**
Submarines, ballistic missile-equipped, nuclear-powered (SSBNs)														
USA	With Polaris A-2	1962	n.a.	16 × A-2	8	8	8	8	6	3	–	–	–	–
	With Polaris A-3	1964	n.a.	16 × A-3	32	26	21	13	13	13	13	11	10	10
	With Poseidon C-3 conv.	1970	n.a.	16 × C-3	1	7	12	20	22	25	28	30	31	31
USSR	'Hotel II'-conv. class	1963	n.a.	3 × 'SS-N-5'	8	8	7	7	7	7	7	7	7	7
	'Yankee'-class	1968	n.a.	16 × 'SS-N-6'	14	21	27	33	33	33	33	33	33	33
	'Hotel III'-conv. class	1972	n.a.	6 × 'SS-N-8'	–	–	1	1	1	1	1	1	1	1
	'Delta I'-class	1973	n.a.	12 × 'SS-N-8'	–	–	–	1	7	12	16	17	17	17
	'Yankee II'-class	1974	n.a.	12 × 'SS-NX-17'	–	–	–	–	1	1	1	1	1	1
	'Delta II'-class	1976	n.a.	16 × 'SS-N-8'	–	–	–	–	–	–	2	6	9	9
	'Delta III'-class	1978	n.a.	16 × 'SS-N-18'	–	–	–	–	–	–	–	–	2	4
				Submarine total: USA	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**41**
				USSR	**22**	**29**	**35**	**42**	**49**	**54**	**60**	**65**	**70**	**72**
				Modern subs: USSR	**14**	**21**	**27**	**34**	**41**	**46**	**52**	**57**	**62**	**64**
SLBM (Submarine-launched ballistic missile) launchers on SSBNs														
USA	Polaris A-2	1962	1 500	1 × 1 Mt	128	128	128	128	96	48	–	–	–	–
	Polaris A-3	1964	2 500	3 × 200 kt (MRV)	512	416	336	208	208	208	208	176	160	160
	Poseidon C-3	1970	2 500	10 × 40 kt (MIRV)	16	112	192	320	352	400	448	480	496	496

USSR	'SS-N-5'	1963	700	1 × 1 Mt	24	24	21	21	21	21	21	21	21	21
	'SS-N-6 mod. 1'	1968	1 300	1 × 1 Mt	224	336	432	528						
	'SS-N-6 mod. 2' conv.	1973	1 600	1 × 1 Mt	–	–	–	–	528	528	528	528	528	528
	'SS-N-6 mod. 3' conv.	1973	1 600	2 × 200 kt (MRV)	–	–	–	–						
	'SS-N-8'	1973	4 300	1 × 1 Mt	–	–	6	18	90	150	230	306	354	354
	'SS-NX-17'	n.a.	..	1 × 1 Mt (MIRV-cap.)	–	–	–	–	12	12	12	12	12	12
	'SS-N-18'	n.a.	4 050	3 × 200 kt (MIRV)	–	–	–	–	–	–	–	–	32	64
				SLBM launcher total: USA	**656**	**656**	**656**	**656**	**656**	**656**	**656**	**656**	**656**	**656**
				USSR	**248**	**360**	**459**	**567**	**651**	**711**	**791**	**867**	**947**	**979**
ICBMs (Intercontinental ballistic missiles)														
USA	Titan II	1963	6 300	1 × 10 Mt	54	54	54	54	54	54	54	54	54	54
	Minuteman I	1963	6 500	1 × 1 Mt	490	390	290	190	100	–	–	–	–	–
	Minuteman II	1966	7 000	1 × 1.5 Mt	500	500	500	500	500	450	450	450	450	450
	Minuteman III conv.	1970	7 000	3 × 170 kt (MIRV)	10	110	210	310	400	550	550	550	550	550
USSR	'SS-7 Saddler'	1962	6 000	1 × 5 Mt	190	190	190	190	190	190	130	30	2	–
	'SS-8 Sasin'	1963	6 000	1 × 5 Mt	19	19	19	19	19	19	19	19	–	–
	'SS-9 Scarp'	1966	6 500	1 × 20 Mt	288	288	288	288	288	288	276	246	192	102
	'SS-11 mod. 1'	1966	5 700	1 × 1 Mt	950	970	970							
	'SS-11 mod. 2' conv.	1973	..	1 × 1 Mt	–	–	–	970	970	970	860	780	670	560
	'SS-11 mod. 3' conv.	1973	..	3 × 200 kt (MRV)	–	–	–							
	'SS-13 Savage'	1969	4 400	1 × 1 Mt	40	60	60	60	60	60	60	60	60	60
	'SS-11 mod. 3'	1973	..	3 × 200 kt (MRV)	–	–	–	20	40	60	60	60	60	60
	'SS-18 mod. 1/mod. 3'	1976	5 500	1 × 20 Mt	–	–	–	–	–	–	32	44	62	92
	'SS-18 mod. 2' conv.	1977	..	8 × 500 kt (MIRV)	–	–	–	–	–	–	–	18	54	114
	'SS-19' conv.	1976	5 000	6 × 500 kt (MIRV)	–	–	–	–	–	–	110	150	230	310
	'SS-17' conv.	1977	..	4 × 500 kt (MIRV)	–	–	–	–	–	–	–	40	70	100
				ICBM total: USA	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**
				USSR	**1 487**	**1 527**	**1 527**	**1 547**	**1 567**	**1 587**	**1 547**	**1 447**	**1 400**	**1 398**
				Total, long-range bombers and missiles: USA	**2 222**	**2 189**	**2 140**	**2 140**	**2 100**	**2 079**	**2 058**	**2 058**	**2 058**	**2 058**
				USSR	**1 875**	**2 027**	**2 126**	**2 254**	**2 358**	**2 438**	**2 478**	**2 454**	**2 487**	**2 517**
Nuclear warheads														
Independently targetable warheads on missiles:				USA	1 874	2 938	3 858	5 210	5 678	6 410	6 842	7 130	7 274	7 274
				USSR	1 735	1 887	1 986	2 114	2 218	2 298	2 886	3 308	4 099	5 153
Total warheads on bombers and missiles, official US estimates:				USA	4 000	4 600	5 700	6 784	7 650	8 500	8 400	8 500	9 000	9 200*
				USSR	1 800	2 100	2 500	2 200	2 500	2 500	3 300	4 000	4 500	5 000*

* 1 January 1979.

For sources and notes, see page 424.

Sources and notes for appendix 7A (pages 422–423)

Sources: The main sources and methodology of this appendix are described in the *SIPRI Yearbook 1974*, pp. 108–109, where a comparable table for the decade 1965–74 appears.

The earlier table has been updated on the basis of material published in the *Annual Report* of the US Secretary of Defense for the fiscal years 1976 through 1980 (US Government Printing Office, Washington, D.C., 1975, 1976, 1977, 1978, 1979) and the statements on *US Military Posture* by the Chairman of the Joint Chiefs of Staff for the same five years.

The version of this table for 1967–76 which appeared in the *SIPRI Yearbook 1976*, pp. 24–27, included revised estimates of the numbers of US strategic submarines and SLBMs of various types, based on the dates of overhaul and conversion of each submarine given in *Jane's Fighting Ships* (Macdonald & Co., London, annual), *Ships and Aircraft of the US Fleet* (Naval Institute Press, Annapolis, Maryland, recent editions), and US Senate Committee on Appropriations annual *Hearings* on naval appropriations. The revised series has been continued, based on the same sources.

The estimates of the numbers of US strategic bombers were revised in the table for 1968–77 which appeared in the *SIPRI Yearbook 1977*, pp. 24–28. The revised series, continued here, is based on a narrow definition of 'active aircraft'—the only definition which permits a consistent time series to be constructed from public data—taking the authorized 'unit equipment' (number of planes per squadron) of the authorized numbers of squadrons of each type of plane and adding a 10 per cent attrition and pipeline allowance (or lower when it is known that adequate numbers of spare aircraft are lacking).

A version of the table covering the period 1967–78 appeared in the brochure containing the SIPRI Statement on World Armaments and Disarmament, presented at the UN General Assembly Special Session devoted to Disarmament on 13 June 1978. That table listed three configurations of Soviet submarine, also shown here ('Hotel III', 'Yankee II' and 'Delta III'), which had not been previously reported. Reference to these configurations, as well as some indication that a 'Golf'-class submarine was deployed in a test configuration with modern SS-N-6 launch tubes, are given in the US fiscal year 1980 defence statements.

Notes:

Dates of deployment

The estimates for the year 1979 are planned or expected deployments.

In the case of the official US estimates of total warheads on bombers and missiles (the last two columns of the table), the estimates for 1979 refer to 1 January. All other estimates in the table follow the more usual practice of official US accounts—which are the main source of the data—by referring to the closing date of the US government fiscal year.

US SLBMs and submarines

The numbers of US submarines and the corresponding SLBMs are derived by treating all submarines under conversion as though they carry their former load until the conversion is completed (shipyard work finished), and they take on their new load from the date of completion. This method, the only exact procedure feasible with public data, differs from the practice in some official US accounts of excluding from the estimates of *total force loadings* (warheads on bombers and missiles) the loads that would be carried by submarines undergoing conversion and treating the submarines as under conversion until the date of their first subsequent operational deployment at sea.

The first of 12 Poseidon-equipped submarines which are to be backfitted with the Trident I (C-4) missile began conversion in the autumn of 1978 and is scheduled to be operational in October 1979. The Trident I missile is expected to have eight 100-kt MIRVed warheads and a range of 4 000 nautical miles (7 400 km). The first Trident submarine, with 24 launch tubes for the Trident I or Trident II missile (the latter now under development), is scheduled to be operational in November 1980.

The maximum payload of the Poseidon missile is 14 warheads, rather than the 10 shown in the table. It is estimated that these missiles actually carry only 10 warheads each, an off-loading undertaken to compensate for poorer-than-expected performance by the missile propulsion system, so that the design range of 2 500 nautical miles can be reached. (In *Combat Fleets of the World 1978/79* (US Naval Institute Press, Annapolis, Maryland, 1978) Jean Labayle Couhat suggests that a range of 2 500 nautical miles can be reached with a 14-warhead payload and that reduction of the payload to 10 warheads increases the range to 3 200 nautical miles.) Estimating Poseidons at their maximum capacity of 14 warheads each, instead of 10, the total number of warheads on US missiles (ICBMs and SLBMs) in 1979 would be 1 984 larger than the 7 274 shown, or 9 258.

US ICBMs

Starting in 1979 or 1980, 300 of the 550 Minuteman III missiles are to be backfitted with the Mark 12A warhead, which carries three 350-kt warheads. Moreover, during the past two years, NS-20 improvements in Minuteman III guidance have brought the expected accuracy (circular error probability) of this missile to about 600 ft. This gives the current 170-kt Minuteman III warhead a better than 50:50 chance of destroying a Soviet missile silo hardened to 1 000–15 000 psi, and two such warheads in succession (barring 'fratricide' effects) about an 80 per cent probability of kill. The hard-silo kill probability of the new 350-kt warhead, given 600-ft accuracy, will be about 57 per cent for one shot and close to 95 per cent for two shots.

Soviet SLBM production and treaty compliance

In mid-1978, as the first two of the new Soviet 'Delta III'-class submarines approached operational status, the USSR reached the SALT I Interim Agreement limit of 62 modern ballistic-missile submarines (34 'Yankee', 26 'Delta I/II', and 2 'Delta III') and 950 ballistic-missile launch tubes on nuclear-powered submarines (27 on the 'Hotel II/III', 540 on the 'Yankee I/II' and 388 on the 'Deltas') and on modern-launcher-equipped, diesel-powered submarines (3, estimated to have been installed on a single 'Golf III'-configured submarine, which was deployed in the mid- to the late-1960s to test the SS-N-6 missile before it became operational on the 'Yankee'-class).

In addition, it is estimated, two more 'Delta III'-class submarines were launched by early 1978 and will be operational by the autumn of 1979.

If the SALT II agreements are concluded and ratified as expected during 1979, then further Soviet construction and deployment of 'Delta'-class submarines with MIRVed missiles, believed to be under way, will no longer be constrained by the old SALT I limits and the voluntary extension of them made by the USA and the USSR.

However, the initial SALT II ceiling of 2 400 strategic delivery vehicles and the later reduction to 2 250 will require that the USSR phase out some of its strategic forces in the years 1979 through 1981. Without such a reduction, the aggregate of Soviet strategic bombers and missiles comes to about 2 520 (not counting 120 patrol- and tanker-configured 'Bear' and 'Bison' aircraft).

No attempt has been made to estimate which systems the USSR will choose to retire in 1979, out of the 140 (or, if other configurations are counted, 260) bomber aircraft; the older, unMIRVed ICBMs (about 100 SS-9s, several hundred SS-11s and 60 SS-13s with unmodified silos); or the older SBLMs (30 launchers on 'Golf'- and 'Hotel'-class submarines and, possibly, early 'Yankee'-class submarines, which might be converted to alternative, tactical roles).

MIRVed warheads on Soviet ICBMs

Firm estimates are available of the numbers of Soviet SS-9 and SS-11 ICBM silos that have been hardened and made capable of launching the SS-18 and the SS-19 or -17, respectively. SS-17 deployments in modified SS-11 silos are proceeding at a slow pace and are reported to involve MIRVed missiles only.

For the SS-18 and SS-19, the rate of silo conversion is faster. However, the numbers of MIRVed missiles placed in the upgraded silos are uncertain. In the case of the SS-18, US Defense Department officials have indicated that both MIRVed (eight-warhead) and unMIRVed (single-warhead) versions have been deployed. No public indication has been given of the evidence concerning the numbers of the MIRVed and unMIRVed types. In the case of the SS-19, the US fiscal year 1980 *Posture Statement* reports that some of the nearly 300 SS-11 silos converted to SS-19 launch configuration continue to have SS-11s installed in them. Thus, the numbers of MIRVed SS-18s and SS-19s remain obscure and possibly unknown.

The SIPRI estimates of the numbers of MIRVed SS-18s and SS-19s rely on assumptions implicit in the US official estimates of total Soviet independently targetable warheads and total numbers of modified silos. These estimates may be revised as more detailed information becomes available.

Soviet and US bomber aircraft

The 1980 US defence literature shows 150 Soviet long-range bombers, rather than the 140 estimate reported for the past decade. The upward revision is probably meant to allow for retired or spare aircraft, not in fully operational status. However, there is in any case some question about the readiness and regularity of training flights of Soviet long-range bombers supposedly in the more active category; and for this reason, the SIPRI estimates have not been revised.

US medium-range FB-111 strategic bombers are shown in parentheses, and long-range bombers only are included in the bomber totals for the first time this year, to clarify the number of delivery vehicles likely to be counted against SALT II limitations. At the time of writing, it appears that SALT II will not cover medium-range bomber aircraft.

The medium-range Soviet bomber Tu-26, code-named 'Backfire', is included in the table only because much attention is given to this aircraft in the United States as a potential strategic delivery vehicle. It is the only weapon system in the table which is not officially recognized—indeed, disavowed—by the deploying government as a strategic weapon system. Moreover, it has been publicly recognized in US intelligence estimates as having less than intercontinental range in normal combat flight profile and as having been deployed at bases with peripherally oriented medium-range bombers and with naval aviation forces. As in the case of the Tu-20 'Bear', the naval aviation-assigned 'Backfires' are not included in the table at all. The medium-range bomber-assigned units, about half of production to date, shown in the table because of their prominence in the debate, are not included in the Soviet bomber totals.

For the past several years, the *Annual Report* of the US Secretary of Defense has included estimates of the total inventory of US bomber aircraft, including a large number of B-52s (221) in inactive storage. It seems that these aircraft may be counted against the SALT II delivery vehicle totals, even though many of them, perhaps most, are not in operating condition, and some may have been cannibalized or allowed to rust. (Almost all are older B-52 C/E/F models.)

In addition, the *Annual Report* has shown the estimated number of Soviet tanker, reconnaissance and maritime patrol aircraft using Mya-4 'Bison' and Tu-20 'Bear' airframes. Most of these aircraft have not been flown as bombers for over 15 years (some never were), and have been substantially modified. It is questionable whether they will be counted against the SALT II limit.

Nuclear warheads

The estimates of independently targetable missile warheads can generally be reconciled with the official US estimates of total bomber and missile warheads if the following steps are taken: (*a*) bomber warhead loads are based on one bomb per 8 000–10 000 kg payload, using Unit Equipment (UE) aircraft for the USA and adding SRAMs (1 140 operational missiles deployed on the bombers during 1972–75) to the internal payload; (*b*) in the case of US SLBMs, load on submarines under conversion and in overhaul are excluded altogether; and (*c*) for some early years, individual MRVs and not just MIRVs are counted separately in the force load total.

8. Strategic anti-submarine warfare and its implications for a counterforce first strike

Square-bracketed numbers, thus [1], *refer to the list of references on page 449.*

Both the USSR and the USA see ballistic missiles carried aboard nuclear submarines as providing the most secure form of deterrent nuclear retaliatory capability. As outlined in chapter 7, this reliance is based on the supposed invulnerability of submarine-launched ballistic missiles (SLBMs) to pre-emptive attack. Such invulnerability is assumed because of the enormous difficulty of locating and destroying all the missile submarines of the opponent in the opening stages of a nuclear attack.

There has been recurrent concern that advances in anti-submarine warfare (ASW) were about to compromise the security of the sea-based deterrent. The threatened breakthrough has not yet taken place. A significant evolution in ASW now seems imminent, however. Whereas no dramatic developments seem likely, a number of trends, particularly in detection technology, appear close to fruition. Once detection and location are achieved, destruction is easy, and ASW weapon systems are already adequate for the task. Even if they are not already operational, these combined developments may soon make it possible to detect, locate and destroy all adversary missile submarines within a time period so short as to effectively eliminate the adversary's sea-based retaliatory capability. In a military sense, the oceans will soon become transparent.

It seems that the USA will soon be able to implement these technologies against the SSBNs (nuclear-powered submarines armed with ballistic missiles) of the Soviet Union. As well as advances in detection technology, developments in ASW weapon systems are also under way, again mainly in the USA. These include notably the 'Los Angeles'-class nuclear-powered hunter–killer submarine and the CAPTOR anti-submarine mine. The technological lead of the USA in both ASW detection and ASW weaponry creates an asymmetry which is enhanced by various geographical factors, in particular the severely restricted access of Soviet vessels to the open ocean.

This chapter concentrates on ASW developments in the USA, which are apparently leading towards a potential first-strike capability. It is generally agreed that Soviet capabilities are somewhat less advanced. A US Congressional Research Service report, for example, states that the

"Soviets apparently have no effective capability for open-ocean ASW, regardless of the scenario envisaged" [1a].

A more detailed evaluation of the situation was made by US Defense Secretary Brown in November 1977 [30]. He said that there is "no definitive Soviet threat today to Polaris/Poseidon SSBNs" and that "There is no evidence that any Soviet weapon or equipment have [*sic*] been developed solely to meet the Polaris/Poseidon threat" although Soviet ASW in general could be so used. The USA had assurances from particular tests carried out that the Soviet Navy was not trailing US SSBNs. Brown noted that the 135 "principal combatants" as well as all patrol combatants in the Soviet Navy had ASW roles, as did 250 submarines and 400 aircraft. However, only about 50 of these, the Ilyushin 38s, are purely for ASW purposes.

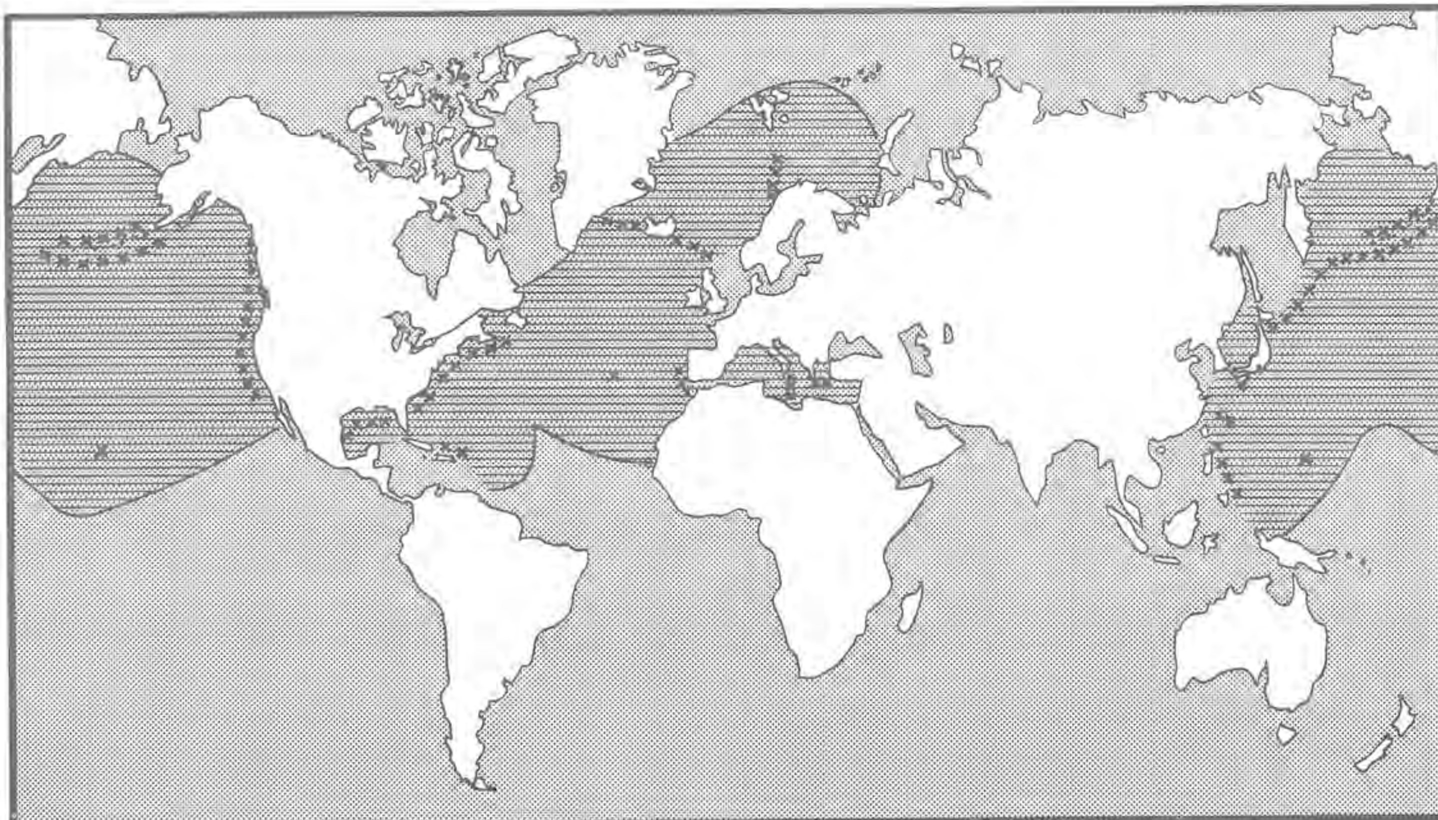
He also noted that the USSR was "conducting applied research in a variety of ASW related acoustic and non-acoustic areas". Yet in the 1980 fiscal report Brown was still able to state that neither the hunter–killer submarine, which "constitutes the most capable Soviet ASW platform . . . nor any other currently deployable Soviet ASW systems represent a serious threat to [US] ballistic missile submarines" [28b].

I. Developments in detection technology[1]

Detection of submarines is achieved primarily by the use of sonar, that is, by sensing underwater sound waves reflected from or generated by submarines. Sound waves travel very long distances underwater. Sonar detection suffers from three limitations, however. The velocity of sound in sea-water is extremely low (compared with light waves) and highly variable, being influenced by salinity, temperature, currents and other factors. Second, the paths followed by sound waves in sea water are difficult to predict, being subject to multiple reflections at the surface and on the sea floor, as well as refraction between layers of different density, and absorption by chemical, biological and gaseous constituents of the sea water. Third, the ocean is a very noisy place due to the abundant marine life, crashing waves, rumbling underwater volcanoes, increasing volumes of merchant shipping and, more recently, increasing seismic exploration and offshore oil drilling activities on the sea floor. These noises tend to hide those of the submarines, or may be misinterpreted as noises made by submarines. Advances in sonar detection of submarines have been achieved primarily by

[1] General principles of ASW were described in the *SIPRI Yearbook of World Armaments and Disarmament 1969/70* (Almqvist & Wiksell, Stockholm, 1970, Stockholm International Peace Research Institute), chapter 3, pp. 93–153.

Figure 8.1: Known and presumed location of US and allied sea-bottom sonar arrays, and probable maximum area over which submarine detection is possible



Sources: Reference [1a], and SIPRI files on foreign military presence.

overcoming these three classes of limitation. The following sections describe the progress made in the USA.

Surveillance sonar arrays

Long-range detection of submarines is carried out mainly by means of large fixed sea-bottom arrays of hydrophones that passively listen for sounds generated by submarines. These arrays are individually and collectively known as SOSUS (Sound Surveillance System). There were stated to be 22 SOSUS installations around the world in 1974 [2]. Both coasts of the USA are supposed to be covered by SOSUS, and they are deployed in other areas in which Soviet submarine movements are particularly intense or restricted. The global distribution of SOSUS and related arrays is shown in figure 8.1.

Each SOSUS installation consists of an array of hundreds of hydrophones laid out on the sea floor, or moored at depths most conducive to sound propagation, and connected by submarine cables for transmission of telemetry. In such an array a sound wave arriving from a distant submarine will be successively detected by different hydrophones according to their geometric relationship to the direction from which the wave arrives. This direction can be determined by noting the order in which the wave is detected at the different hydrophones. In practice the sensitivity of the array is enhanced many times by adding the signals from several individual hydrophones after introducing appropriate time delays between them. The result is a listening 'beam' that can be 'steered' in various directions towards various sectors of the ocean by varying the pattern of time delays. The distance from the array to the sound source can be calculated by measuring the divergence of the sound rays within the array or by triangulating from adjacent arrays.

SOSUS had its beginnings in 1952 when attempts were first made to exploit the sound duct that lies between the sun-heated surface layers of the ocean and the deeper, permanently frigid water below. The first hydrophone array, called CAESAR, began operating in 1954 and was soon followed by further installations all along the US Atlantic coast. The first arrays had no beam-forming capability and functioned simply as detection barriers, with several hydrophones per kilometre of barrier. In the 1960s additional barriers were built along the Pacific coast, in much deeper water, and in several overseas locations under various names such as Trident, Artemis, Barrier and Bronco. There was a continuous improvement programme. Early CAESAR had poor range-estimation capability and had to be supplemented either by explosive sound sources for calibration or by sonar picket ships located 300 km offshore. In general the early systems were able to locate submarines at distances of up to about 150 km [3, 4].

In the early 1960s techniques for array signal processing began to be introduced at the shore monitoring stations and the detection range was extended to several hundred kilometres [5]. Such increased sensitivity, however, led to problems in identifying all the sound sources detected. The solution was to develop an integrated surveillance system combining sea-bottom arrays, surface ships and aircraft. This integration will be described further in connection with airborne surveillance.

Currently the detection and identification range of sea-bottom arrays is being further extended under a major DARPA (Defense Advanced Research Projects Agency) programme called Project SEAGUARD, which is focused on three areas:

(*a*) large acoustic array technology—improvements in hydrophones, telemetry and mooring techniques;

(*b*) signal processing—new array processing techniques, automatic search, detection and recognition;

(*c*) ocean hearing—establishing further the spatial and temporal variation of all the factors that influence sound propagation [6a].

Overall, Project SEAGUARD is intended to determine the fundamental physical and technical limitations of acoustic surveillance.

In the field of array technology, DARPA has developed more sensitive hydrophones which are cheaper to deploy and which counter the effects of submarine silencing techniques. They are optimized to detect noise resulting from the submarine's passage through the sea, rather than engine noise. The signal processing study has involved feeding enormous amounts of acoustic data in real time from widely scattered sea-bottom arrays into a computer complex called Illiac 4. Sometimes described as "the world's largest number cruncher", Illiac 4 actually consists of 64 conventional computers working in parallel and sharing a one-billion (10^9) bit bulk memory. It operates at a rate of 150 million instructions per second and is located at Ames Research Center in California. Illiac 4 has applied to sonar arrays the signal processing techniques originally developed for seismic arrays. These techniques were intended to separate out the 'coherent' signal of a distant nuclear explosion from all the 'incoherent' seismic noise generated by crustal processes, ocean waves, industrial activity, and so on.

It has been found that, unlike seismic propagation, acoustic propagation within the oceans is far more coherent than was formerly suspected. In other words, signal processing can filter out all other noise while amplifying the signal from a submarine, and submarines become potentially detectable from thousands of kilometres away. The quantities of data required are quite enormous, and assembling the data is in itself a large-scale process. The US Navy and DARPA have, however, been acquiring experience in this using ARPANET, a network of large computers of diverse types linked by high speed, high volume data links. Designing and implementing such a complicated network took several years. Its operation requires millions of messages a minute in a complex pattern from sensors to computers, between computers and from computers back to sensors. The seemingly insoluble 'switchboard' problem was solved by development of a technique called packet switching. Packet switching involves breaking up the messages into short digitized 'packets' each typically of 128 to 255 characters, and each prefixed with a code which describes the address and the priority of the message. The packets are fed into the communications network, and at each node of the network a computer reads the prefix and sends the packet on its way by the best communications link available at that particular moment. At the destination another computer collects up all the packets of one particular message as they arrive on various links. The packets are juggled back into their original order, the prefixes are removed, and the message is again available in its original form.

Airborne surveillance

The P3 Orion provides the basis of US airborne anti-submarine capability. The Orion is a four-engined aircraft capable of flying 2 500 km, patrolling for four hours in search of a submarine, and returning to base. It is equipped with a variety of submarine detection systems but relies mainly on sonobuoys.

The P3 Orion has undergone continuous improvements in the 18 years it has been operational, and the current P3-C version carries over 300 'black boxes', that is, discrete electronic systems performing various detection and navigation functions [7]. The Orion is now equipped to use active sonobuoys which determine the azimuth as well as the range of echoes reflected off target submarines, while current passive sonobuoys monitor 10 times the frequency spectrum of earlier models. In an updating programme which began in 1974, the Omega navigation system was fitted to the Orions. This resulted in considerable augmentation of Orion capabilities by limiting the formerly quite large navigational errors that built up on 10-hour missions out of sight of landmarks and relying on inertial and Doppler navigation aids (navaids), which are both subject to cumulative errors over time. With Omega, overall errors were limited to 3 km or so. From 1971, Omega navaids were also fitted to ASW surface vessels and hunter–killer submarines. This was particularly valuable to the hunter–killer submarines since reception was possible at a depth of 15 metres. It also benefited the coordinate operation of airborne, surface and sub-surface ASW platforms by allowing them all to navigate on the same navigational grid, within which relative errors were limited to about 200 metres. In a current updating programme, aircraft are being fitted with improved electronics for fixing the positions of sonobuoys relative to the aircraft, and for recording data from them.

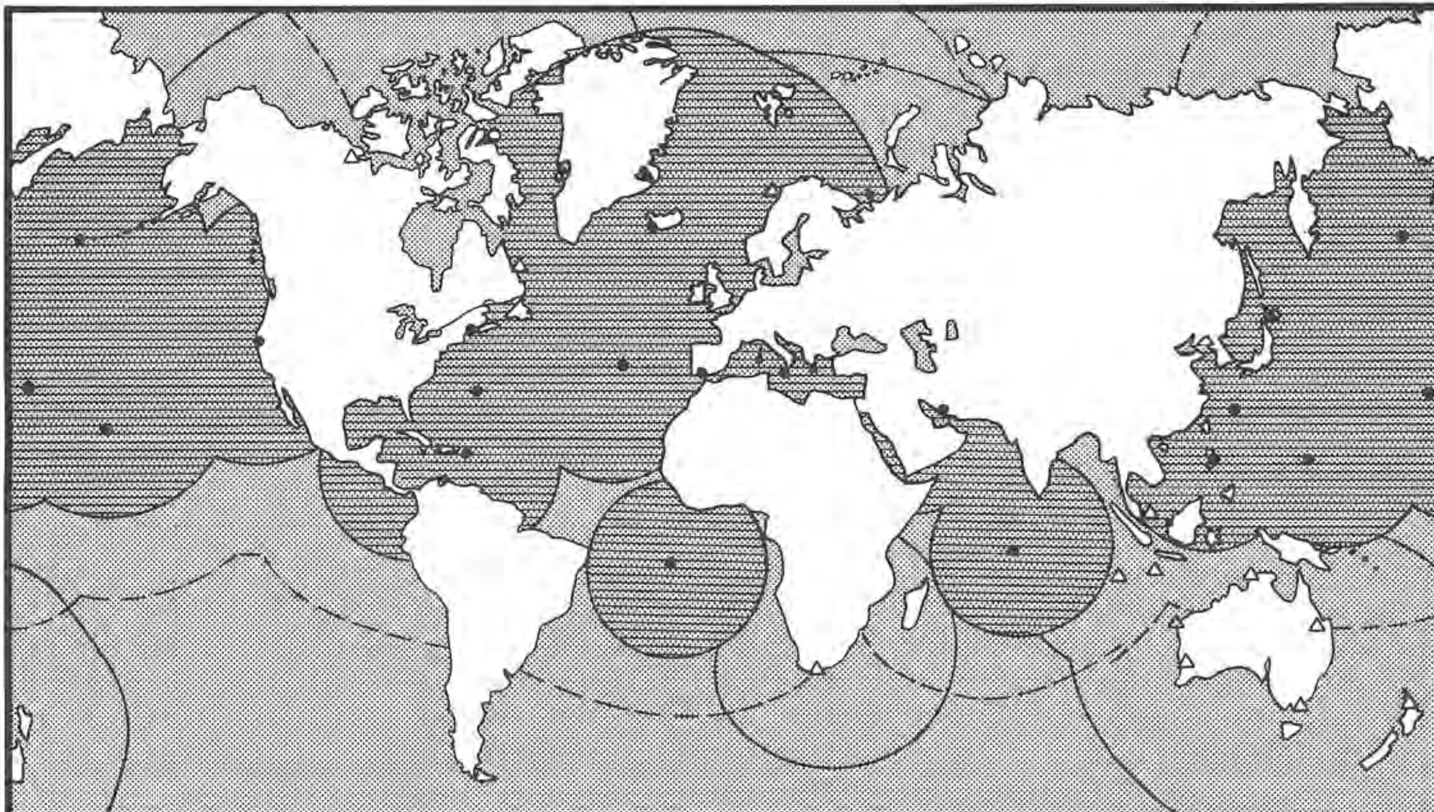
The next cycle of improvements to the Orion, called Update III, will, it is claimed, provide the best ASW aircraft in the world. This will be largely due to the provision of an advanced signal processor called Proteus [8], which will process data from the sonobuoys and other sensors to fix positions of target submarines and determine the best offensive measures. A new, fully integrated and programmable communications suite will provide simultaneous links via satellite and other radio nets. An improved MAD (Magnetic Airborne Detection) unit, using cryogenic magnetometers, will double the range at which submarines can be detected by their magnetic signature.

The USA has 400 P3 Orions, of which over 200 are in active service [9a]. They are based world-wide, and can operate from a number of alternative airfields. Figure 8.2 shows the location of Orion bases. Assuming a usual operating range of 2 300 km, the map shows the area of ocean accessible to US Orions, together with the areas covered by the ASW aircraft of US allies, and the extra area that could be covered if shorter patrol times were acceptable or if aerial refuelling capability were added (something which is under consideration). It can be seen that, without assistance from allies or aerial refuelling, an area of about 51.5 million km^2, including all ocean areas in which Soviet missile submarines are likely to be found, is covered. A single Orion can search 725 000 km^2 in the course of one mission. The capabilities of the Orion, however, are best used not in wide area searches, but in narrowing down the location of a hostile submarine already detected by SOSUS-type fixed arrays. The SOSUS arrays are said to be able to locate a submarine within a circle of about 50 km diameter, and it is widely believed that they can locate to within 15 km or so. Thus an Orion or other ASW plane need only search an area of a few hundred square kilometres which SOSUS intercepts have indicated to contain a submarine. The aircraft are sent out on what is known as a vectored intercept.

The DARPA research into signal processing and other improvements is leading to new operational modes which will provide for more accurate location and identification of submarines. This will allow ASW aircraft to be more accurately vectored to their targets and fewer air missions would need to be flown [11a].

There are many other aircraft besides the US Orions involved in

Figure 8.2. US airborne marine reconnaissance coverage of the oceans



Note: Circles indicate airfields from which US Orions operate. Shaded area indicates coverage assuming four hours on station. Broken lines indicate additional coverage if no time is spent on station or if aerial refuelling were to become available. Solid lines indicate additional coverage provided by US allies from airfields marked by triangles.

Sources: References [9a, 10], and SIPRI files on foreign military presence.

hunting Soviet and WTO submarines. There are something like 600 Orion-type aircraft in NATO and to this must be added the aircraft of countries, such as Australia, New Zealand and Japan, which share the task of patrolling the open ocean and monitoring ocean choke points (see table 6.4).

Other developments

The sonobuoys sown from aircraft have limited lifetimes, are very much more limited in range, and have less directional discrimination than the sea-bottom sonars. Sea-bottom sonars can be laid only in relatively secure waters, near the shores of friendly states, and in time of war they are very vulnerable to a wide range of countermeasures. In particular their connecting cables can very easily be cut. This can be done by an ordinary trawler, and often occurs accidentally. Two innovations are intended to overcome these limitations.

The first is the use of towed sonar arrays. The USA currently has six Towed Array Surveillance Systems (TASS) in operation. Due to necessary compromises in design, these have limited capabilities. SURTASS (Surveillance Towed Array Surveillance System), currently under development, incorporates technology with capabilities an order of magnitude better than TASS, and comparable with those of the sea bottom arrays. The achievement of such capability has involved overcoming some formidable technical problems. Before signal processing can be carried out, for example, the on-board computer must know the exact orientation of every hydrophone in the array, and its spatial relationships to the array. SURTASS data will be relayed to shore processing sites by satellite. The US Navy is currently procuring three SURTASS units, each valued at about $33 million. SURTASS operates particularly in the low frequency part of the acoustic spectrum, to enhance its long-range capabilities. Low frequency operation necessitates a 'wide aperture' array, in other words a very long array, which can be towed only at very slow speeds.

The second innovation is the MSS (Moored Surveillance System), recently renamed RDSS (Rapidly Deployed Surveillance System). This consists basically of a very large sonobuoy, of the same dimensions as a Mark 46 torpedo, and capable of being delivered by any vehicle that can carry a torpedo. RDSS can thus be dropped from Orions, B-52s and various carrier-based aircraft, or it can be more secretively positioned by release through the torpedo tubes of a submarine. RDSS has obvious advantages for surveillance operations in such high-interest areas as ocean choke points, and the approaches to Soviet SSBN bases. RDSS is described as intended for use in crisis areas requiring quick-reaction surveillance.

Once delivered, the RDSS deploys a string of hydrophones down towards the bottom, and anchors itself. This it can do in depths of as much as 6 000 metres. MSS will be relatively unaffected by future advances in submarine quietening, since it is optimized for the detection of noise resulting from water flow around submarine hulls, and cavitation noise associated with submarine propellers, rather than engine-room noise. A buoy at the surface periodically transmits compressed bursts of data which are so short that hostile direction-finding on them is difficult, and these data are picked up by aircraft in the vicinity or, perhaps in the future, by satellite. Each RDSS buoy can remain active for up to a month or so, and it is responsive to radio command so that it can be turned on only when needed.

Both SURTASS and RDSS are described as a response to changes in Soviet submarine-operating patterns [12]. SURTASS and RDSS will function as part of the integrated surveillance system of which SOSUS is the principal component. Even working independently, past towed arrays are said to "have demonstrated a potential for the (deleted) passive detection, classification and localization of submarines in most operational modes under most environmental conditions" [12].

The Proteus advanced signal processor being designed for the Orion is capable of handling RDSS data. Proteus will also be provided for other ASW platforms including surface ships and hunter–killer submarines. By using the same equipment in all platforms, the interoperability of and coordination between various ASW platforms are made possible. According to US Navy testimony to Congress, "The integration of SURTASS detection information with that obtained from other undersea-surveillance system elements will enable the dissemination of highly accurate, near real-time, evaluated target data for follow-up action by tactical ASW forces" [11b].

Global oceanographic monitoring

One of the key problems in the analysis of all kinds of sonar data, whether collected by sea-bottom, submarine-mounted, or sonobuoy sonar, is the determination of propagation parameters—how fast the sound waves are travelling in the ocean, the extent to which they are being bent as they pass through various layers, the number of bounces between the surface and the floor of the ocean, and so on. Acoustic propagation is strongly influenced by various physical and chemical variables of sea water, and in particular by temperature, salinity and current velocities. Considerable effort has, therefore, gone into the investigation of these variables, and into devising systems for the global collection of synoptic information on them.

This experimentation began in the 1960s, at the same time as the potential long-range capabilities of sea-bottom sonar began to be recognized. In 1964 the US Naval Ordnance Laboratory carried out Project Neptune, in which 120 depth charges were dropped by ships and aircraft over wide ranges of ocean between Bermuda in the Caribbean and Perth in Australia. This experiment conclusively demonstrated long-range propagation—detonations near Capetown were heard 10 000 km away, near New Zealand, with a primitive sonar array [13]. A major experiment was carried out in 1972 aimed at achieving a near-synoptic calibration of the Pacific Ocean. In this experiment, called Kiwi One, 300 small depth charges were dropped in the course of a flight from Panama to New Zealand and back, with other aircraft dropping bathythermograph buoys so that ocean-wide thermal profiles could be charted [14].

There are numerous satellites which contribute to global monitoring of the oceans. The list includes the Defense Meteorological Satellite Program (DMSP), the improved TIROS operational weather satellite, the Stationary Meteorological Satellite (SMS/GOES), the Landsat series, the Applications Technology Satellites (ATS), the Nimbus series, the Skylab manned observatories, TIROS-N and SEASAT. Still more are under development, including Stormsat, Applications Explorer Mission (AEM-4), Remote Ocean Measurement System (ROMS) and Synchronous Earth Observatory Satellite (SEOS).

DMSP is a weather satellite originally launched to meet USAF requirements in the South-East Asian War. The current satellites have sensors of 0.6 km resolution, and have proved excellent for mapping sea ice, and determining sea-surface temperatures. Knowledge of sea-ice distribution is important not only for surface ASW operations, but also for determining sonar-propagation conditions—some sea-ice undersurfaces tend to absorb rather than reflect sound waves. The TIROS-N satellite is a civilian version of DMSP, with military participation in its operation and in the use of the data. The Navy operates its own ground terminal for the Geostationary Operational Environmental Satellite (GOES).

ATS, NIMBUS, and perhaps other satellites, are important because of the equipment they carry for relaying data from remote, unattended buoys to land stations. Earlier Nimbus satellites carried the Interrogation Recording and Location System (IRLS), while Nimbus 6 carries the Random Access Measurement System (RAMS). In the latter system the remote buoy transmits for one second every minute. The transmission carries a 4-digit identifier and four 8-digit data words. Different data can be transmitted in alternate transmissions. These data are recorded by the satellite during the 20-minute passage which it makes twice a day, at local midday and midnight. The data are played back to a ground station in a later orbit. Such buoys can simply send data on currents, as indicated by daily changes in the position of the buoy, or they can send back temperature profiles, or even direct sound-velocity measurements made by a series of sensors suspended at various depths beneath the buoy. SEASAT is a particularly important satellite flown by NASA to test several concepts in ocean sensing. It is described in detail in chapter 4. One SEASAT can monitor the oceans of the world once every 36 hours, and the combination of sensors carried can measure sea state (wave height), wind speed and direction, wave direction, and ocean temperature. It is planned eventually to have six SEASAT-type satellites in orbit, so that all oceans will be monitored every six hours. SEASAT has the important advantage over the weather satellites that its microwave sensors not only see through cloud, but work equally well in the dark and in sunlight. It is thus better equipped to measure sea-ice cover in the polar areas during winter, for example. SEASAT is a National Aeronautics and Space Administration (NASA) programme, but its operation is controlled by a committee that includes Defense Department representation, and it is partly financed out of the Defense budget. NASA supplied data from the SEASAT terminal in Alaska, via a communications satellite, to the Navy's Fleet Numerical Weather Central in California [15].

An important innovation with SEASAT was the incorporation of hardware to enable the satellite itself to determine its own position to within 10 metres by receiving signals from the Defense Department NAVSTAR satellites. The value of this for the surveillance role of the satellite is obvious. The synthetic aperture radar aboard SEASAT is capable of resolving targets on the sea surface as small as 25 metres. This means that even quite small fishing vessels can be located on the ocean. The value of this for ASW is that it enables identification of some of the noises that enter the SOSUS arrays: once identified, they can be filtered out. Identification and location of sound sources also aid in real-time calibration of the range-estimating function of the SOSUS arrays.

Another powerful technique for ocean monitoring over large areas is back-scatter over-the-horizon radar (OTH-B) [16, 17]. OTH-B uses high frequency radio waves which are beamed towards the ionosphere. At this point they are bent down towards the Earth, scattered, and reflected by the Earth's surface or by targets of military interest, such as ships and aircraft. Some of the scattered radio energy returns by the same path to sensitive receivers located near the transmitters. By spectral analysis of the clutter signal returned to the receiver from the sea surface, the average wavelength, the direction of the waves, and the velocity of the wind that drives them can all be determined. The US

Navy has for some years been operating a trial OTH-B radar in Maine, which was able to determine these parameters over an area of 16 million square kilometres, including most of the likely North Atlantic patrol area for Soviet 'Yankee'-class and older ballistic missile submarines. A second trial radar was more recently built on San Clemente Island on the Pacific Coast of the USA to test the technique in the Pacific. An operational OTH-B radar is now under construction to cover the North Atlantic and another one may be built in the Pacific North-west.

Satellite-borne lasers offer another possibility for global sounding of the oceans. Blue–green lasers have exceptional penetration capabilities —to depths of 100 metres or more in clear weather—and are under investigation as possible communication modes with submerged submarines, and for detection of submerged submarines. A spin-off is that a coupling of the laser beam with the molecular resonance of the water molecules can generate Raman frequency shifts and polarization shifts; analysis of the signal return as a function of depth can generate temperature and salinity profiles.

Another aspect of global ocean monitoring is the mapping of all the sound sources that are being registered by the SOSUS and other sonars, so that surface ships of no interest can be distinguished from hostile submarines. The Director of DARPA has pointed out that

> at any particular time, there are several thousands of maritime merchant ships crossing the world's oceans. Each of these ships constitutes a potential source of acoustic interference to [the US] undersea surveillance system. Merchant ships are not designed for quietness, they are designed for economical transport and their high powered propulsion systems generate a great deal of noise which is well coupled to the ocean's acoustic propagation path [18].

SEASAT, as already noted, has demonstrated a potential for contributing data that helps filter out these noise sources. OTH-B is also at least potentially useful in this role, and does not suffer from the six-hour delay involved in use of SEASAT data. Orion aircraft including the ferret EP-3A aircraft, which detect ships by their own radar emissions, and ferret satellites, that perform the same function from space, probably also help. More recently, the 'White Cloud' ocean-surveillance satellites have become available to track surface vessels by their radar emissions, and soon 'Clipper Bow' radar satellites will be tracking all vessels from space—including those maintaining radio frequency silence. Finally, there is the AMVER system, in which the merchant ships of many nations report their own positions to the US Coast Guard for search and rescue purposes. The US Coast Guard relays this information to the US Navy's Ocean Surveillance Information System.

Exotic detection techniques

In anticipation of Soviet progress in quietening, and in recognition of the fact that acoustic detection systems can be flooded with noise either unintentionally, as with merchant ships and sea-bottom mineral exploitation, or intentionally, by screening submarines with surface vessels or using noise generators to jam sonars, there has been a continuous effort to expand the range of non-acoustic detection techniques.

Magnetic detection is one of the most promising lines of enquiry. It has already been mentioned that cryogenic SQUID magnetometers have doubled or tripled the range of magnetic airborne detection. This detection range now makes it feasible to install magnetic detectors on the sea bottom, and it is reported that this technique is being investigated for the Greenland–Iceland–UK (GIUK) gap.

The US Navy maintains a satellite series called Solrad–hi which measures variations in solar activity, and the resulting variations in the Earth's magnetic field ('magnetic storms' and so on). Knowledge of these events is necessary for MAD to distinguish between magnetic anomalies caused by submarines, and those caused by geophysical factors [19a].

Submarines also produce perturbations of the electric field of the ocean, which are potentially detectable. One approach uses large electric coils laid out on the sea bottom. The US Navy is also sponsoring research into the methods by which some marine organisms can detect extremely small perturbations in electric fields. One species of ray, for example, can detect field changes of 0.01 microvolts. Charges induced by submarines are considerably larger.

Submerged submarines also generate thermal anomalies, which are potentially detectable at the surface, either from the heat released from the reactor through the condenser heat exchangers, or as a result of wake turbulence mixing cold deep water into the warmer surface layers. It has been suggested that the infra-red sensors now being fitted to the Orions can detect such thermal anomalies, but this equipment is more usually described as being for the detection and identification of surface targets at night by means of their smoke-stack thermal signatures. Infra-red sensors on board weather and oceanographic satellites have a very high degree of thermal resolution, but lack the spatial resolution to detect the relatively small upwellings from submarines. This situation may well change in the near future, however, with the continuing rapid development of new kinds of spaceborne infra-red sensors. These include large arrays of very small detector elements, composed of Josephson-junction detectors, super Schottky diodes, or charge-coupled devices, being developed as 'staring' sensors (as distinct from the more usual scanning-type of infra-red sensor). Most of this work is directed towards the development of more sensitive space-based missile early warning systems, and satellite-surveillance systems, but the range of wavelengths covered is such that the techniques are potentially applicable to submarine detection.

Blue–green lasers are another possibility for submarine detection from space. Laser detection of submarines from the air has already been successfully demonstrated with a device called ORICS (Optical Ranging Identification and Communication System) [8]. Lasers, however, suffer rather fundamental depth limitations and limited swath widths, because the laser beam must be at near-perpendicular incidence to the sea surface. A great many satellites would therefore be needed for laser detection of submarines.

Investigations of surface wake effects of submerged submarines are more promising. Just as a surface ship produces a V-shaped wake which may persist for several kilometres behind the vessel, so a submerged submarine produces a conical wake which intersects the surface at some distance behind the submarine. The turbulence caused by the passage of a submarine is also expressed at the surface in various ways which may be summarized under the term hydrodynamic signature.

Hydrodynamic signatures are potentially detectable with OTH radar. An upwelling of water alters the morphology of surface waves, something that is detectable with OTH-B. The wake itself may be expressed as a much longer wavelength undulation, potentially measurable with OTH-B thanks to a higher-order interaction between the ocean waves and the electromagnetic waves, giving rise to second-order harmonically generated Doppler lines in the radar return. The director of DARPA noted in May 1974 that DARPA was investigating the application of OTH radar "to the detection of ships, *submarines*, SLBMs and cruise missiles" [italics added] [20].

Satellites of the SEASAT type also have the potential of detecting hydrodynamic signatures. Upwellings resulting from the passage of a submarine can bring water of different temperature, salinity and biological content to the surface, and these can all result in a water mass of different dielectric constant, which is detectable by microwave radiometry from satellite altitudes [21]. Also the long-wavelength undulation is potentially detectable by the radio frequency altimeter carried by SEASAT, which has 10 cm vertical resolution.

The infra-red techniques already described are another way of detecting hydrodynamic signature.

II. Anti-submarine weaponry

Having examined the anti-submarine detection systems, it remains to take a brief look at the weapons that can be used against submarines once they are located. The USA has three weapon systems of importance for strategic ASW—the Orion, the hunter–killer submarine and the Captor mine.

Perhaps the most important ASW weapon platform in the US forces is the P-3 Orion, already described as one of the detection platforms. The Orion can carry Mark 46 acoustic torpedoes and nuclear depth charges. The Mark 46 torpedo has a range of about 10 km, a running speed of 45 knots, and homes in on its target acoustically. If it misses or overshoots the target on its first attempt, it is capable of turning and making further attempts.

Nuclear depth charges are capable of creating over-pressures within the ocean capable of imploding any submarine within MAD range.

It can be assumed that these weapons, the Mark 46 torpedo, and the Mark 57 and Mark 101 nuclear depth charges, have almost complete certainty of destroying any submarine already detected and located by the aircraft's sensors. To guard against possible future developments in quietening and acoustic countermeasures, the US Navy has embarked upon the Neartip improvement programme for the Mark 46. For the fiscal years 1979 and 1980, 1 260 Neartip torpedoes have been requested. Looking further ahead, an advanced lightweight torpedo is being developed to replace the Mark 46. This will go faster, dive deeper, reach targets at greater range, and have a higher probability of success than the Mark 46.

The other important US ASW platform is the hunter–killer or attack nuclear-powered submarine (SSN). Naval sources consider the nuclear-powered attack submarine to be the best ASW platform in existence today. It has the advantage of operating in the same medium as the target. Sonar detection is enhanced by the hunter–killer submarine's ability to operate at depths optimal for propagation. It can use more sophisticated hydrophones than can be built into an Orion sonobuoy, and it creates lower self-noise levels than surface vessels.

The US Navy is currently involved with the construction of the SSN-688 or 'Los Angeles' class of hunter–killer submarine [22a]. Four have already been built, 32 are already authorized by Congress, and a total of 42 is planned for delivery during the 1980s. Including other hunter–killer submarine classes, the USA will have 90 hunter–killer submarines by 1983.

The SSN-688 has been described as the most combat-capable submarine in the world, with higher speed, lower noise levels, and more advanced sensors and counter-measures than other US hunter–killer submarines.

The heart of the SSN-688 detection capability is its 15 tonne AN/BQQ-5 sonar system. This is distinguished by a digital signal processor of unprecedented complexity and performance. The signal processing routines are said to be effective against such counter-measures as torpedoes equipped with recorded submarine sounds intended to make the sonar lose track. According to the US Congressional Research Service, "the result of US superiority in digital computer technology and electronics may be an SSN capability to trail Soviet submarines without their knowledge, and if detected to maintain trail against even a determined and uncooperative Soviet commanding officer" [1b].

Hunter–killer submarines carry Mark 48 torpedoes, which are much larger, and more capable, than the Mark 46 already described. They have a higher speed, longer range, and are either acoustic-homing or wire-guided.[2] Hunter–killer submarines also carry the nuclear-warheaded SUBROC ASW missile. This is launched from an ordinary torpedo tube, rises to the surface, flies as a missile for up to 50 km, re-enters the ocean in the vicinity of the target, and explodes as a nuclear depth charge.

SUBROC is to be replaced by Tarpon, a crossbreed of the Mark 46 torpedo with a Harpoon cruise missile, which will have a range of about 100 km.

The CAPTOR ASW mine [22b] basically consists of an encapsulated Mark 46 torpedo with equipment to enable anchoring to the sea floor. This mine is equipped with acoustic sensors which can distinguish between surface vessels and submarines (and, according to some sources, between WTO and NATO submarines). When a submarine is detected, the torpedo is released and homes in on the submarine at distances of up to 10 km.

According to the US Under Secretary of Defense for Research and Development, "Analyses show that, within the limits in which it can be employed, CAPTOR will kill more submarines per dollar than any other ASW system" [9b].

In time of war, CAPTOR minefields can be rapidly sown across all the choke points through which Soviet submarines must pass. Although it can be delivered by ship or submarine, CAPTOR is most likely to be delivered by air. B-52 bombers can carry 18 CAPTOR, while Orions and carrier-based A-6s or A-7s can each carry 6 [19b]. Based on the presumed range of the Mark 46, the CAPTOR mine has a theoretical

[2] For a more detailed description see chapter 6.

kill radius of about 10 km. Only some 500 CAPTOR would be needed to seal off the GIUK gap. It would take only 28 B-52 sorties to deliver this quantity, and the USA has a minimum of 60 B-52s prepared for minelaying [23]. Thus the GIUK gap could be sealed off in a few hours at most. Any breaches opened up in this barrier as a result of mines being activated against penetrating submarines could be readily filled by later B-52 sorties.

Congressional testimony about CAPTOR is rather heavily censored and the maximum depth at which CAPTOR can be anchored is not clear. In 1977, however, a world map was released which showed the 500 fathom contour. It was remarked that this line closed off some of the major world straits, including the GIUK gap. This depth was said to be the "general point where (deleted) are capable of use" [19c]. This is probably a reference to CAPTOR. The next paragraph described "the only areas of the world which will not be minable . . . which will be beyond (deleted) for our newer mines and those of the Soviets". These areas include only deep sea trenches and mid-ocean abyssal plains.

Another mine of strategic importance is the submarine-launched mobile mine (SLMM). This consists of a Mark 37 torpedo with its torpedo firing mechanism replaced by a mine mechanism. "The SLMM is the only mine in [the] current [US] inventory or projected inventory with a covert standoff laying capability. That is the submarine can stand off to a distance of (deleted) yards, can shoot this torpedo, if you will, with the mine actuator in it, the torpedo runs to its designated location, sinks to the bottom, and is an active mine" [19d].

The USA has many other ASW systems and platforms, including various classes of ASW destroyer, LAMPS (Light Airborne Multi-Purpose System) and other ASW helicopters and carrier-based S-3A Viking ASW aircraft. The latter carry basically the same sensors and weapons as the Orion. These are generally thought of as tactical ASW systems,[3] however, to be used for defending aircraft-carrier task forces, convoys, the North Atlantic sea lanes and so on. They make an indirect contribution to US strategic ASW capability, however, insofar as their existence frees the Orions and SSNs to concentrate on strategic roles.

III. Trend towards first-strike capability against missile submarines

A 1974 SIPRI study of ASW dismissed the possibility of a first-strike attack against missile submarines by noting that it would require

[3] The distinction between tactical and strategic ASW has been examined in a 1974 SIPRI publication [24].

continuous trailing of every missile submarine from the moment it left port until the moment it returned [24a]. Five years later this no longer seems to be the case as regards US ASW against Soviet missile submarines. A first strike against Soviet submarines might even be considered a more attractive alternative than a damage-limiting strike launched during the course of a nuclear war in an attempt to limit the destruction caused by retaliatory submarine-launched missiles. This is due to the Soviet policy of keeping only some 10 missile submarines at sea. If near-complete surprise could be achieved, it is obviously simpler to locate and destroy 10 submarines at sea, and the rest of the SSBN fleet at its moorings, than it is to try to hit a significant proportion of the fleet of 90 or so SSBNs once they have put to sea, particularly amidst the disruption of a global nuclear war.

The feasibility of such a first strike can be illustrated in terms of a purely speculative scenario. It is designed simply to illustrate the dimensions of the problem and is not in any way intended to suggest that the USA is preparing for such a contingency. It also assumes that Soviet SSBN operating procedures remain much the same as they are now.

In this scenario it is supposed that the USSR has only 10 SSBNs at sea, perhaps two in the Pacific, four in the north Atlantic and four in the Barents Sea. Submarines departing from Murmansk to the Atlantic Ocean and the Barents Sea will have been monitored by photographic, and perhaps electronic, reconnaissance satellites, and the progress of the Atlantic submarines will have been successively monitored by Norwegian Orions, sea-bottom sonar between Norway and Bear Island [1c], the well-documented SOSUS barrier across the GIUK gap (generally regarded as having 100 per cent detection capability), and by British Nimrod ASW aircraft. Once the submarines have passed out of the British area of responsibility into the Atlantic proper, they are monitored by US Navy systems. SOSUS installations on Bermuda and the Azores, SURTASS and remotely emplaced RDSS buoys will follow them in the mid-ocean 'holding areas', and US coastal SOSUS will detect any that come within 'Yankee'-class firing range. The SOSUS fixes will be calibrated with oceanographic data obtained in real time by various satellites, mid-ocean buoys and Orion-dropped acoustic velocity measuring buoys. From time to time the Orions will make vectored intercepts of the submarines to verify the SOSUS recordings. The SSBNs in the Pacific will be subject to a similar pattern of surveillance, although perhaps less thorough. They will be monitored by fixed sonars as they pass through the various Japanese straits, and then monitored by SOSUS, Japanese aircraft and US Orions. If necessary Australian and New Zealand Orions will assist.

So far, this scenario describes the present situation, except that SURTASS and RDSS are not yet available.

If, then, the USA were to decide to launch a first strike, still assuming surprise, it would have between 200 and 400 Orions available to hunt down those 10 submarines. Such a ratio obviously provides plenty of surplus capacity to check out with sonobuoy and MAD the more dubious SOSUS signals, and plenty of overkill to ensure that all hostile SSBNs are hit within the very limited time span within which a first strike must be carried out. This is without taking into consideration more tactically oriented ASW forces, such as carrier-based S-3As and ASW destroyers, which could also be directed against SSBNs as opportunity permitted. The role of the hunter–killer submarines will be mentioned below.

The 'Delta'-class submarines in the Barents Sea pose more of a problem. Their departure from Murmansk would be observed and they would be subject to at least intermittent monitoring by sea-bottom sonar. The Barents Sea is shallow, however, and partly covered by sea ice, two factors which pose problems for ASW. In particular, shallow seas provide unfavourable conditions for long-range sonar propagation [25], and the sea ice prevents sonobuoys from being sown from aircraft. The proximity of the Barents Sea to the USSR makes Orion aircraft, surface vessels and submarines vulnerable to attack.

It may be that, for the time being, the USSR has established a successful sanctuary for some of its SSBNs, thanks to the long-range missiles carried by the 'Delta'-class submarines [26].

In 1976 this was regarded as one of the most important reasons why the USA could not achieve a successful first strike. The Defense Department's Deputy Director for Strategic and Space Systems concluded his disavowal of first-strike doctrine to the Senate Armed Services Committee as follows: "I haven't touched yet at all on the problem of eliminating his [i.e., Soviet] submarine-based missiles. Remember, his submarine-based missiles are long range missiles, at least the newer ones, and it appears that this is the way his SLBM forces are going. This means he can station most of them in the Barents Sea." (Further testimony deleted by censor) [27]. The Deputy Director went on to say that any substantial US ASW force in the area would attract countermeasures, and that the Barents Sea was far too forbidding a place for a US presence to be maintained.

There are now indications that the USA does not intend to let the Barents Sea remain a sanctuary for Soviet SLBMs much longer. The US Secretary of Defense has virtually served notice to this effect. His report for fiscal 1979, which has been widely interpreted as proclaiming a further shift towards counterforce doctrines (see the Introduction, page 14), noted that "Because of our current interests as well as our historical commitments, we are bound to have a strategic stake in such distant places as the Sea of Japan, the Strait of Malacca, the Persian Gulf, the Dardanelles, the Baltic, and the Barents Sea" [28a].

Elsewhere in the same report it was noted that "Soviet naval forces must cope with particularly awkward operating conditions . . . They have to invest in the defense of the Barents Sea and the Sea of Japan" [28a]. This seems to indicate quite a change since 1976 when the Senate Armed Services Committee was told that, as far as the Barents Sea was concerned, "[the USA] will occasionally send a ship up there to establish that it is international waters but an occasional ship and a task force are two different matters" [27].

If the USA were to attempt to eliminate SSBNs from the Barents Sea, it would have at its disposal, among other weapon systems, a considerable number of hunter–killer submarines, including 'Los Angeles'-class submarines. The very features of the Barents Sea that make Soviet submarines hard to find would also make it difficult for the USSR to observe or hit US hunter–killers. US surveillance resources in the Barents Sea could be built up gradually and covertly, particularly with devices such as the RDSS.

Returning to the hypothetical first-strike scenario, it remains to examine the fate of more than four-fifths of the Soviet SLBM force still in port. As far as is known, the USSR has little underground accommodation cut into the fjord walls near Murmansk, so these submarines are all highly vulnerable to US ICBM and SLBM attack, and possibly to bomber attack, if the air defences are penetrable. According to the US Chief of Naval Operations, "Our plan would be as the first line of defense to strike . . . the submarine bases from which the nuclear powered submarines operate" [9c].

If complete surprise were not achieved, a proportion of the remaining fleet might be able to put to sea. It is at this point that the scenario starts to falter. There are conceivable ways of dealing with this problem, however. 'Yankee'-class and older submarines would have to transit the GIUK gap in order to be within firing range of the USA: this could be prevented by a barrier of CAPTOR mines laid in a matter of hours across this gap and perhaps further north between the north-west corner of Norway and Greenland, or across the Norway–Spitsbergen gap. 'Delta'-class submarines might be subjected to a 'rolling barrage' of megaton-size nuclear explosions before they fully dispersed. Each such explosion can create overpressures sufficient to crush a submarine over an area of about 350 km^2.

Potential of US ASW forces for survival

An important consideration when attempting to assess the extent to which any weapon system is intended for first- or second-strike roles is its ability to survive the opening stages of a nuclear war. Credible retaliatory or damage-limiting forces must be survivable, first-strike systems need not be. By this criterion some aspects of ASW would seem more suited to a first-strike role.

The ASW surveillance systems are particularly vulnerable. The sea-bottom sonar arrays are highly vulnerable to jamming and spoofing, and the cables linking the hydrophones are easily cut, even by ordinary fishing trawlers. This happens continuously, by accident or design, in peacetime [29]. The SOSUS shore stations are also very vulnerable. A US Navy spokesman has noted that "SOSUS stations are vulnerable to a wide range of physical threats. The Navy has recognized this vulnerability and taken it into account in system planning". Further testimony was largely censored, and the only details left in the text about protective measures were that chain-link fences surrounded the installations, and personnel were equipped with and trained to use small arms [9d].

SURTASS is even more vulnerable. These mobile sonar arrays will be towed by vessels which "are to be built as non-combatants" [9e], which will be unarmed, have civilian crews, and will be capable of only 11 knots without array and 4 knots with array extended.

Until recently the Orions have been totally without defensive weapons. They are relatively slow turbo-prop engined aircraft with large radar cross-section. They are now being fitted with Harpoon missiles in order to give them an anti-ship capability, but they are still defenceless against air attack. Other aspects of ASW are, however, much better adapted to survival. In particular, the hunter–killer submarines are well suited to a damage-limiting role during nuclear war. But, as Senator McIntyre of the US Senate Armed Services asked recently, "It seems that the starting point and foundation for ASW is the SOSUS system. Yet the SOSUS system appears to be very vulnerable, particularly the land based terminals . . . Are we basing our ASW on a capability that could easily be wiped out in the opening days of a war?" [9d].

IV. Summary and conclusions

There are numerous official and near-official US statements which reflect a considerable degree of optimism about US ASW capabilities against the USSR and, on the other hand, about the invulnerability of US missile submarines to Soviet ASW.

It is still the declared policy of the USA not to acquire the capability to eliminate the other side's deterrent; hence it is never officially admitted that the ASW forces are directed against missile submarines. However, the nature of these forces, and their global distribution, suggest that the distinction between tactical ASW against attack submarines and strategic ASW against missile submarines is already becoming indistinct.

The dilemma of the present situation is that deployment of constantly improved ASW systems, even if they are only intended for tactical roles, inevitably results in a strategic first-strike capability. When this capability exists, there will be temptations to use it, and there will be a perception by the other side that it can be used.

Expressions of US confidence in ASW are abundant. Admiral Kauffman testified that the USA had a predominant lead because of advances in sensors, weapons and submarine quietening [6b]. US Secretary of the Navy W. G. Claytor is reported to have said that the "qualitative edge that we hold over the Soviets in both equipment and personnel is awesome and our ability to orchestrate the many components of the United States' antisubmarine warfare team into an effective submarine killer force has enormously improved in recent years" [31].

Concern about the implications is well summarized in a US Congressional Research Service report prepared for the House Committee on International Relations [1a, 32]. This report notes the ambiguity between strategic ASW and tactical ASW, particularly in areas close to the USSR, and quotes official sources to the effect that in time of war the USA would not discriminate between missile submarines and other types. It accepts the fact that the USA does not at this moment have the capability to eliminate Soviet sea-based missiles, but points out that research and development is leading in this direction, and that Soviet decision-makers have grounds for fearing such a capability.

The situation as a whole demands urgent attention. If the USA achieves a first-strike capability against Soviet ICBMs, as appears to be one of the objectives of the M-X programme, and if this is coupled with maintenance of the present lead in ASW, there are serious grounds to fear that the concept of mutual assured destruction, with all its faults, will be abandoned in favour of a war-fighting and war-winning strategy.

References

1. *Evaluation of Fiscal Year 1979 Arms Control Impact Statements: Toward more informed congressional participation in national security policy-*

making, Report prepared for the Subcommittee on International Security Scientific Affairs of the Committee on International Relations, US House of Representatives (US Government Printing Office, Washington, D.C., 1978), Chapter 5, Part II, Arms control implications of antisubmarine warfare (ASW) programs.
(a) —, pp. 103–17.
(b) —, pp. 109–10.
(c) —, p. 110.
2. *Department of Defense Appropriations, Fiscal Year 1975*, Hearings before the Committee on Appropriations, US Senate, 93rd Congress (US Government Printing Office, Washington, D.C., 1974), Part 3, p. 444.
3. 'Undersea "R & D" covers up for Caesar's ghost', *Electronics*, Vol. 42, No. 21, 13 October 1969, p. 6.
4. 'Navy testing antisub alarms', *Electronics*, Vol. 34, No. 2, 13 January 1961, pp. 26–27, 29.
5. Booda, L., 'ASW: A holding action?' *Sea Technology*, Vol. 19, No. 11, November 1978, p. 12.
6. *Authorization for Military Procurement, Fiscal Year 1978*, Hearings before the Committee on Armed Services, US Senate (US Government Printing Office, Washington, D.C., 1977).
(a) —, pp. 6179, 6188, 6224, 6292.
(b) —, Part 10, p. 6756.
7. Turner, Vice Admiral F.C., 'US marine patrol aircraft: A status report', *US Naval Institute Proceedings,* Vol. 104, No. 1, January 1978, pp. 106–11.
8. 'Advanced sensors major anti-submarine warfare goal', *Aviation Week and Space Technology*, Vol. 106, No. 5, 31 January 1977.
9. *Authorization for Military Procurement, Fiscal Year 1979*, Hearings before the Committee on Armed Services, US Senate (US Government Printing Office, Washington, D.C., 1978).
(a) —, Part 8, p. 6335.
(b) —, Part 8, p. 5820.
(c) —, Part 5, p. 4321.
(d) —, Part 8, p. 6350.
(e) —, Part 8, p. 6345.
10. Heppe, R. E. and Channel, L. E., 'Fixed wing aircraft in ASW', *National Defense,* Vol. 63, No. 351, November–December 1978, pp. 52–70.
11. *Authorization for Military Procurement, Research and Development, Fiscal Year 1976*, Hearings before the Committee on Armed Services, US Senate, 94th Congress (US Government Printing Office, Washington, D.C., 1975).
(a) —, p. 2976.
(b) —, p. 4469.
12. *Department of Defense Appropriations, Fiscal Year 1977*, Hearings before the Committee on Appropriations, US Senate (US Government Printing Office, Washington, D. C., 1976, Part 4, p. 1064.

13. Kibblewhite, A. C. *et al.*, 'Long range sound propagation study in the southern ocean and Project Neptune', *Journal of the Acoustical Society of America,* Vol. 38, No. 4, pp. 629–43.
14. Thorp, W. H. and Schumacher, W. R., 'Project Kiwi One cruise report', Naval Underwater Systems Center Report No. TD-4455, February 1973.
15. *NASA Authorization for Fiscal Year 1978*, Hearings before the Committee on Commerce, Science, and Transportation, US Senate, 95th Congress (US Government Printing Office, Washington D.C., 1977), p. 1616.
16. Curley, S. R., 'Measurements of mid-ocean conditions by over-the-horizon radar', *Naval Research Reviews*, Vol. 26, No. 11, p. 1.
17. Barrick, D. E., Headrick, J. M., Bogle, R. W. and Crombie, D. D., "Sea backscatter at HF: Interpretation and utilization of the echo", *Proceedings of the IEEE*, Vol. 62, No. 6, June 1974, p. 673.
18. *Department of Defense Appropriations for Fiscal Year 1978*, Committee on Appropriations, US Senate, 95th Congress (US Government Printing Office, Washington, D.C., 1977), Part 5, pp. 83–84.
19. *Military Posture and HR 5086: Department of Defense Hearings for Fiscal Year 1978*, Hearings before the Committee on Armed Services, House of Representatives, 95th Congress (US Government Printing Office, Washington, D.C., 1977).
   (a) —, Part 4, Book 1, p. 752.
   (b) —, Part 4, p. 563.
   (c) —, Part 4, p. 229.
   (d) —, Part 4, p. 225.
20. Pretty, R. T. (ed.), *Jane's Weapon Systems,* 1978, p. 613.
21. Swift, C. T., Preface Special Issue on Radio Oceanography, *IEEE Transactions on Antennas and Propagation,* Vol. AP725, No. 1, January 1977, p. 1.
22. *Fiscal Year 1979 Arms Control Impact Statements,* Statements submitted to the Congress by the President, Committee on International Relations, US Congress, and Committee on Foreign Affairs, US Senate (US Government Printing Office, Washington, D.C., June 1978).
   (a) —, pp. 164–68.
   (b) —, pp. 175–80.
23. Day, B., "The B-52: growing more vital with age", *Air Force Magazine,* Vol. 62, No. 2, February 1979, pp. 32–37.
24. *Tactical and Strategic Antisubmarine Warfare* (Almqvist & Wiksell, Stockholm, 1974, Stockholm International Peace Research Institute).
   (a) —, pp. 39–42.
25. Ingenito, F., 'Sound propagation in shallow ocean water', *Naval Research Reviews*, Vol. 31, No. 3, March 1978, pp. 3–15.
26. Østreng, W., 'The strategic balance and the Arctic Ocean: Soviet options', *Cooperation and Conflict: Norwegian Journal of International Politics*, Vol. 12, No. 1, 1977, pp. 41–62.
27. *Authorization for Military Procurement, Research and Development,*

Fiscal Year 1977, Hearings before the Senate Armed Services Committee (US Government Printing Office, Washington, D.C., 1976), Part II, p. 5939.

28. *Department of Defense Annual Report for Fiscal Year 1980*, Secretary of Defense Harold Brown (US Department of Defense, Washington, D.C., January 1979).
    (a) —, pp. 31, 36.
    (b) —, p. 74.
29. Wilson, G. C., 'Navy says trawlers foul sub detection', *International Herald Tribune*, 17 June 1978.
30. *Supplemental Authorization for Appropriations for Fiscal Year 1978 and Review of the State of US Strategic Forces*, Hearings on HR 8390 before the House Committee on Armed Services, US Congress (US Government Printing Office, Washington, D.C., 1977), pp. 203–209.
31. Weintraub, B., 'Navy chief says U.S. has best submarines', *New York Times*, 25 May 1978, p. 6.
32. Pincus, W., 'Study warns of effect on SALT. US anti-sub systems seen "far ahead"', *Washington Post*, 10 January 1979.

9. The prohibition of inhumane and indiscriminate weapons

Square-bracketed numbers, thus [1], refer to the list of references on page 461.

I. Introduction

The 1979 United Nations Conference on Prohibitions or Restrictions of Use of Certain Conventional Weapons which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects is the first major international conference called to prohibit or restrict the use of specific conventional weapons since the Hague Peace Conferences at the turn of the century.

Prohibiting or restricting the use of certain weapons is no substitute for disarmament. Disarmament remains the first priority but, in the meantime, international rules backed by a powerful public opinion may limit some of the more outrageous excesses of war. International agreements to ban some of the more inhumane or indiscriminate of weapons may also contribute to building a climate of opinion more conducive to real measures of disarmament. Restrictive measures may reduce the number of war victims and increase, rather than diminish, the security of peoples.

This chapter examines the background to the UN Conference and reviews developments in the field since 1974.[1]

II. Humanitarian criteria

The work of the 1979 UN Conference is based upon the principle, introduced in the St Petersburg Declaration of 1868, that weapons should be designed as far as possible to be sufficient to put a man out of action, no more and no less [3]. Weapons should be directed only at the military forces of the enemy, not at civilian populations. These guiding principles are the basis of international humanitarian law and are reconfirmed in the two Additional Protocols to the Geneva Conventions, drawn up in 1977 and now in force.

They also form the basis of a series of conferences of government experts, under the auspices of the International Committee of the Red Cross, leading up to the 1979 Conference [4–6].

Although the general St Petersburg principles are still accepted, it

[1] Previous reviews are to be found in references [1, 2].

would seem desirable to examine their implications in more detail, taking into account developments in medicine as well as in military technology. Critics argue that all weapons are inhumane, and this is true. But nonetheless, it is possible to distinguish between various weapons in terms of their effects on individual combatants or on civilian populations. In making such a distinction the following factors can be taken into account:

(*a*) the magnitude and the severity of the wounds caused,
(*b*) the duration of the effects of the injury,
(*c*) the possibility of delayed effects,
(*d*) the area of coverage of the weapon,
(*e*) the possibility that the effects can spread beyond control of the user, and
(*f*) the possibility that the effects can persist in time.

III. Updating the Geneva Conventions

From 1971 to 1977, the International Committee of the Red Cross took the lead in reaffirming and developing international humanitarian law as codified in the four Geneva Conventions of 1949. The culmination of this work was achieved at a Diplomatic Conference in Geneva in 1977, where two new protocols were agreed upon, the first applying to international armed conflicts and the second to non-international armed conflicts (see chapter 14).

The major thrust of these protocols is to increase the protection of civilian populations in time of war and to improve the treatment of the wounded and prisoners of war. The problems arising from guerrilla warfare and wars of national liberation were given careful consideration.

Some of the texts agreed upon rule out means of warfare which have been common in recent decades. In particular, the area bombardment of inhabited areas is prohibited, as is the destruction of crops and structures holding back 'dangerous forces', such as dams and nuclear power stations.

It is also prohibited to employ means of warfare which cause widespread, severe or long-term damage to the environment.

The new protocols represent a significant step forward in international law, even though nuclear weapons and developments in precision weapons technology make some of the prohibited means of warfare obsolete.

The greatest weakness of the new protocols is that nuclear powers claim that they do not cover the use of the most inhumane and indiscriminate of all weapons—nuclear weapons. However, as part of the effort to update the Geneva Conventions, a major attempt has been made to prohibit or restrict the use of certain specific conventional weapons. Three conferences of government experts were held as part of this effort, and a number of proposals for specific prohibitions or restrictions of use were put before the Diplomatic Conference.

These proposals covered such weapons as napalm and other incendiary weapons; high-velocity, small-calibre small arms ammunition; certain types of fragmentation weapon; fuel–air explosives (FAE); and delayed-action weapons such as mines and booby-traps. A number of other weapons, such as lasers, were discussed but have not as yet led to specific proposals. Attention was also given to the problem of international control of new weapons.

The question of prohibition or restriction of use of specific weapons proved a sensitive one, with the major military powers threatening to withhold their signatures from the new protocols if specific weapons were so much as mentioned. The joint efforts of the military blocs succeeded in just avoiding the two-thirds majority required to include a reference to specific weapons. This undoubtedly represents a defeat for the majority in the international community which favours restrictions.

However, by way of a countermove, a resolution was introduced to the Diplomatic Conference—and accepted by the majority—asking the United Nations to convene a separate conference on specific conventional weapons in 1979. The United Nations agreed both in the General Assembly and at the Special Session on Disarmament.

IV. Recent developments in specific weapons

Incendiaries

Napalm and other incendiary weapons have been described in detail in two reports [7, 8]. These reports include information on some new incendiary agents using thickened pyrophoric agents like triethyl aluminium. By varying the amount and type of thickening agent, these substances can be made to burn faster or slower. They burn with a very hot flame, producing a 'chemical fireball' with sufficient radiant energy to cause third-degree burns within a few seconds to nearby persons even though they are not in direct contact with the flames. Previously, nuclear weapons were the only ones to produce such radiant heat.

The principal criticisms against incendiary weapons are that they are inhumane and indiscriminate in their effects. Severe burns from napalm, phosphorus or other incendiaries are generally regarded by surgeons to be among the most severe traumata to which the human body can be subjected. However, death from severe burns may well be delayed. If the victim survives the initial shock, he suffers increasing and excruciating pain as the wounds heal, though they may never do so unless skin transplant techniques are available. Burn wounds typically lead to hideous disfigurement and disabling contractures which handicap the victim both physically and socially. Skin cancers developing later in life are frequent, and subsequent heart, kidney or respiratory failure are a permanent threat. Thus, burn wounds fall under all criteria of superfluous injury.

Further, fire caused by incendiary weapons can spread in ways which cannot be controlled by those deploying the weapons, and consequently there is a particular danger of indiscriminate effects.

The new protocols to the Geneva Conventions ban indiscriminate attacks by any means including incendiaries. Some of the proposals so far put forward to restrict the use of incendiaries would do no more than repeat this prohibition. However, what is at issue now is whether the effects of incendiaries on individual combatants are so inhumane as to warrant a ban on their use on the battlefield. Tactical battlefield use of napalm bombs increased from some 14 000 tonnes in World War II, and 32 000 tonnes in the Korean War to some 400 000 tonnes in the Viet Nam War [8].

Small arms and ammunition

For nearly a century it has been known that the wounding effects of a bullet are largely a function of the velocity, since the kinetic energy of a bullet increases with the square of the velocity but linearly with the mass [9]. However, the severity of the wound depends upon how much of this energy is transferred to the body. More energy is transferred if the bullet deforms, breaks up or tumbles wildly in the body. These factors can be largely controlled by the bullet designer, depending upon whether the intention is to create a larger or a smaller injury.

Most contemporary rifle bullets are derived from designs introduced during the 1890s. They usually have a calibre of 7.62 mm and a muzzle velocity of about 750–850 m/s. There are two basic types: the full-power type, with a lethal range of 800 or more metres, such as the standard NATO round, and the intermediate power type, with a range of about 400 m, such as the standard Soviet assault rifle round. Studies during and after World War II concluded that most engagements with small arms fire take place at much less than 400 m, 100 m being a usual range. Consequently, when long-range, high-powered rifles are used at short range they cause excessive injuries. For the same reason, the

NATO round causes more severe injuries than the WTO round when used at the same range.

A new trend was initiated by the introduction of the US M-16 5.56-mm high velocity round during the Viet Nam War.

According to a US Army report, "the M16 muzzle velocity was higher than that of its predecessor, the M14, which significantly increased the destructiveness of the bullet at close range" [10].

It is this increased destructiveness which is a major subject of contention in the current international debates. Although for diplomatic reasons it has been disputed, considerable confirmatory evidence is now available as a result of international experimental studies as well as clinical reports [9].

Studies also indicate that it is possible to design a smaller calibre bullet having the logistic advantages of the M-16 without causing such severe wounds. This is a matter of great current importance, since the NATO countries are at present testing a variety of new light-weight weapons and ammunition with a view to adopting a replacement for the existing standard weapons [11]. If a more destructive bullet is chosen, it may spur the WTO countries into adopting the very destructive Soviet 5.6-mm sporting round, already available, thereby unnecessarily promoting a new step in the escalation of suffering.

The basic principles of wound ballistics have been known since before the 1899 Hague Conference and there is no reason why international limits on bullet designs cannot be arrived at. Such limits should pay attention not only to the propensity of the projectile to break up, deform or tumble in the wound, but also to its velocity. Recent studies have shown that even small steel spheres (where tumbling plays no role) can, at high velocities, cause very severe injuries.

According to a report in a medical journal,

> In the next decade these velocities will probably double to values of 2 to 3 km. sec^{-1}. At the same time the size of the projectiles will decrease. This . . . could produce a significantly different type of disabling wound than previously encountered . . . This type of wound would be particularly disabling and may require new approaches to [wound treatment] [12].

Coupled with the trend towards ever-higher velocities is a trend towards increased rates of fire or multiple projectiles, both of which increase the likelihood of multiple injuries.

Fragmentation weapons

The development of fragmentation weapons continues with the emphasis on the use of new steels and cast irons in naturally fragmenting weapons, and the increased use of proximity fuzes to make shells explode over the target area rather than in the ground, greatly magnifying effects against personnel and light matériel. Because of their very high initial velocity, even very small fragments can cause severe wounds.

Small steel spheres are commonly used as preformed fragments. Experiments show that, at high velocity, these spheres may cause larger wounds than fragments of the same mass and initial velocity [13].

Cluster bombs and dispensers designed to distribute small 'bomblets', mines or grenades over a wide area continue to appear. The USA produced many different types during the Viet Nam War and procured more than 1.5 million of them [9]. Western sources report that the USSR has a comprehensive range of these weapons. The British BL 755 has been supplied to several countries. The West German MD1, currently under development, is one of the largest. It weighs some 4 500 kg and is designed to scatter some 4 000 small bombs or rockets over areas of up to 500 x 2 500 m.

In 1975, extracts of the US Rules of Engagement in Viet Nam were published [14]. These extracts were particularly noteworthy for suggesting ways in which some of the indiscriminate effects of the use of fragmentation weapons could be reduced. They are therefore well worth study by the international community. They are analysed in reference [9]. They show that it is necessary and possible to determine safety zones for specific weapons in order to protect civilian populations (see appendices 9A and 9B).

Blast weapons

Fuel–air explosives are the most significant development amongst blast weapons. They have greater explosive force than an equivalent weight of TNT. FAE weapons can cause severe blast injuries, with high lethality, over relatively large areas (depending, of course, on the size of the weapon). Hitherto, pure blast injuries have been rare in combat, since casualties are more likely to result from fragments [9].

Although the principle of FAEs was tried out during World War II, it was only during the past decade that the technical problems of dispersing and detonating the gas at the right moment were solved. There is considerable scope for future development. FAEs have strategic and tactical as well as humanitarian implications. The very first question put to incoming US President Carter at his first presidential press conference concerned the possible export of these weapons. (It was later announced that they would not be exported to Israel.)

Early reports of the use of FAE bombs in Viet Nam described casualties apparently asphyxiated from lack of air. This account is misleading.

The victims are indeed asphyxiated in many cases, but this is because the membranes of the lung are ruptured by the blast, not because of the lack of oxygen.

It is a moot point whether FAEs can be described as "asphyxiating or deleterious gases" in the sense of the Hague Declaration. They asphyxiate by physical rather than chemical means. For the victim, the effects are similar whether the lungs are burst or corroded by chemicals, as during World War I.

Delayed-action munitions

The indiscriminate effects of delayed-action munitions dropped with bombs, for example, are well known. New problems are arising, however, with the development of new types of scatterable mine (for use both on land and in waterways) which, for the first time, permit the offensive use of mines far behind enemy lines as well as in front of them [9]. The USA procured more than 114 million such land-mines during the Viet Nam War.

The problem of immediate indiscriminate effects must be dealt with by means of more restrictive rules of use. But rules regarding construction are also required. For one thing, delayed-action fuzes are usually less reliable than impact fuzes, so that a higher proportion of dud munitions remain as a long-term hazard. In some cases, more than 50 per cent of munitions fail to function properly [9]. (For proximity fuzes, as much as 15 per cent failure is apparently the accepted design standard.)

In a proposal being put before the international community by the UK and other countries, rules are formulated with regard to the use of land-mines and booby-traps. The proposals are quite sound as far as conventional minefields are concerned, but treat remotely delivered mines as a separate category with fewer restrictions. Neither indicators that an area is mined nor self-destruct devices fitted to mines can offer adequate safeguards to the inhabitants of cities over which mines are scattered, for which reason the international community should resist the invitation to legitimize such uses. Remotely delivered mines should be restricted at least as severely as hand- or mechanically-emplaced mines.

Some of the long-term problems resulting from delayed-action munitions such as mines, and other unexploded munitions, were indicated in a report prepared by the UN Environment Programme as a result of a UN resolution.[2] The debate on this report revealed a need to establish

[2] UN Resolution 3435, 9 December 1975. The UNEP General Council discussed the preliminary report of the Executive Director (UNEP/GC/103 and Corr.1) on 19 May 1977, and in decision 101(V) it requested the Executive Director to pursue the matter further; this decision was endorsed by the General Assembly in Resolution 32/168 of 19 December 1977.

the responsibility for the disposal of mines and other remnants of war. It is clearly intolerable that civilian populations should suffer for decades because foreign states have fought each other in their territory, as is the case in parts of North Africa today, or because of massive foreign military intervention, as in Indochina.

New weapons

A number of new weapons—including light-flash devices, high-intensity sound generators and electric shock apparatus—have already been used in police and para-military operations.

The most likely candidate for a completely new type of battlefield weapon is the laser. Laser weapons (as distinct from ancillary devices such as guidance systems and rangefinders) have already shown themselves capable of destroying matériel targets such as missiles in flight. They are now being developed for field conditions.

The special characteristics of lasers offer certain military attractions as anti-personnel weapons. The growing importance of optical equipment on the battlefield as an aid to improving the combat effectiveness of personnel and weapons generates increasing interest in means of destroying such equipment and crews using it, such as anti-aircraft crews. The laser is ideal for this purpose, since optical equipment and the eyes of the crews using it are particularly sensitive to laser beams. However, from a humanitarian point of view there is something particularly disturbing about the prospect of a weapon which burns out people's eyes. Protective goggles, which might be made available to military forces, are less likely to be supplied to civilians.

V. Basic tasks for the UN Conference on inhumane weapons

The basic principle of the St Petersburg Declaration—that weapons should be designed only with the intention of disabling the military forces of the enemy—is fully compatible with the UN Charter restrictions on the use of force.

The tasks before the UN Conference, therefore, can be summarized as follows:

1. To reaffirm and develop the principles of St Petersburg in the light of the UN Charter, paying attention in particular to:

(*a*) the protection of the civilian population (indiscriminate area weapons, and weapons whose effects spread or persist);

(*b*) the protection of combatants (the magnitude and severity of injuries, the duration of effects, delayed effects);

(*c*) the protection of the human environment (magnitude and severity of effects, long-term or delayed effects, removal of remnants of war).

2. To prohibit or restrict the use of specific weapons. The most important priorities are:

(*a*) a ban on the use of nuclear weapons (a priority which will probably be studiously overlooked);

(*b*) a ban on incendiary weapons, including white phosphorus and new incendiary agents;

(*c*) a ban on bullets which tumble or break up within 150 mm of tissue (the length of an average wound in the human body) and on multiple-projectile bullets;

(*d*) a ban on fuel–air explosives;

(*e*) restrictions on the use of fragmentation weapons within specified zones of inhabited areas;

(*f*) a prohibition on mines which cannot be located and disposed of by known means;

(*g*) an obligation on those who employ munitions such as mines to ensure their removal at the end of hostilities; and

(*h*) restrictions on the use of mines, booby-traps and other delayed-action munitions in order to minimize civilian casualties.

References

1. *World Armaments and Disarmament, SIPRI Yearbook 1973* (Almqvist & Wiksell, Stockholm, 1973, Stockholm International Peace Research Institute), chapter 5.
2. *World Armaments and Disarmament, SIPRI Yearbook 1975* (Almqvist & Wiksell, Stockholm, 1975, Stockholm International Peace Research Institute), chapter 4.
3. *The Law of War and Dubious Weapons* (Almqvist & Wiksell, Stockholm, 1976, Stockholm International Peace Research Institute).
4. *Weapons that may Cause Unnecessary Suffering or have Indiscriminate Effects,* Report on the Work of Experts (International Committee of the Red Cross, Geneva, 1973).
5. *Conference of Government Experts on the use of Certain Conventional Weapons* (Lucerne, 24 September–18 October 1974), (International Committee of the Red Cross, Geneva, 1975).
6. *Conference of Government Experts on the Use of Certain Conventional Weapons* (Second Session—Lugano, 28 January–26 February 1976), (International Committee of the Red Cross, Geneva, 1976).
7. *Napalm and other Incendiary Weapons and all Aspects of their Possible Use*, Report of the Secretary-General, A/8803/Rev.1 (United Nations, New York, 1973).

8. *Incendiary Weapons* (Almqvist & Wiksell, Stockholm, 1975, Stockholm International Peace Research Institute).
9. *Anti-personnel Weapons* (Taylor & Francis, London, 1978, Stockholm International Peace Research Institute).
10. Hay, J.H. (Lt. Gen.), *Tactical and Matériel Innovations,* Vietnam Studies (US Department of the Army, Washington, D.C., 1974), p. 51.
11. Cormack, A.J.R., 'The NATO small arms trials', *International Defense Review,* Vol. 11, No. 7, 1978, pp. 1043–48.
12. Charters, A.C. and Charters, A.C., 'Wounding mechanism of very high velocity projectiles', *Journal of Trauma,* Vol. 16, No. 6, 1976, pp. 464–470.
13. Mendelson, J.A. and Glover, J.L., 'Sphere and shell fragment wounds of soft tissues: experimental study', *Journal of Trauma,* Vol. 7, No. 6, 1967, pp. 889–914.
14. *US Congressional Record,* 6 June 1975, pp. S 9897–9905.

Appendix 9A

The US Rules of Engagement in Viet Nam as they relate to certain specific weapons

On 6 June 1975, extracts of the Rules of Engagement applicable to US forces in Viet Nam were published in the *US Congressional Record* (pp. S 9897–9905). They comprised the following documents:

1. US Military Assistance Command, Vietnam, Directive Number 525–13, dated May 1971 (Unclassified contents), including the following Annexes:

   Rules of Engagement—Surface Weapons Excluding Naval Gunfire;
   Rules of Engagement—Fixed Wing Air Operations;
   Rules of Engagement—Rotary Wing Air Operations;
   Rules of Engagement—Naval Gunfire.

2. Excerpts from various directives concerning rules of engagement and operating authorities for Southeast Asia.
3. Regulation Number 525–4, 16 March 1968, Headquarters, Americal Division, APO San Francisco, Combat Operations, Rules of Engagement.
4. Regulation Number 525–1, 30 January 1968, Headquarters, 11th Infantry Brigade, APO San Francisco, Combat Operations, Rules of Engagement.
5. Change 1, Regulation 525–1, 10 April 1968, Headquarters, 11th Infantry Brigade, Americal Division, Combat Operations, Rules of Engagement.
6. Change 1, Regulation Number 525–1, 9 February 1968, Headquarters, 11th Infantry Brigade, APO San Francisco, Combat Operations, Rules of Engagement.

This was the first time these Rules had been published. The published versions are incomplete and originate from various periods of the Viet Nam War and must accordingly be interpreted with some care. Extracts referring to the use of specific weapons follow.

Incendiary munitions

Document 1, dated May 1971, introduced under 'General Rules' an instruction that "The use of incendiary type munitions in inhabited or urban areas will be avoided unless friendly survival is at stake or is necessary for the accomplishment of the commander's mission"

(Paragraph 6 (*d*) (1)). Annex 1 of the same document states, with regard to direct-fire, flat-trajectory weapons that "All types of munitions, except incendiary (white phosphorus), may be used in direct fire weapons including flechette (beehive), HEAT[1] and canister rounds" (Paragraph 3 (*e*) (2) (*c*)).

A directive issued on 16 March 1968 (document 3) states: "The employment of any ordnance which would cause intentional burning of dwellings will be avoided, unless absolutely necessary in the accomplishment of the commander's mission (Paragraph 5 *b* (3) (*b*))".

A regulation of 30 January 1968 (document 4) states with regard to attacks on villages and hamlets: "The use of incendiary type ammunition will be avoided unless absolutely necessary to successful accomplishment of the mission" (Document 4, paragraph (5) (*d*)).

Chemical munitions

The General Rules provided in document 1 state that

> Riot control agents will be used to the maximum extent possible. CS agents can be effectively employed in inhabited and urban area operations to flush enemy personnel from buildings and fortified positions, thus increasing the enemy's vulnerability to allied firepower while reducing the unnecessary danger to civilians and the likelihood of destruction of civilian property (Paragraph 6 (*d*) (2)).

Small arms

A regulation of 30 January 1968 states with regard to the employment of individual and crew-served small arms and automatic weapons (including the M-16 rifle, the M-60 machine-gun, the M-79 grenade launcher, the M18A1 Claymore anti-personnel mine, the M-26 grenade, the .50 calibre machine-gun, and the 90 mm and 106 mm recoilless rifles) that they may be used against:

> (1) Enemy personnel observed with weapons who demonstrate hostile intent either by taking a friendly unit under fire, taking evasive action, or who occupy a firing position or bunker.
> (2) Targets which are observed and positively identified as enemy.
> (3) Point targets from which fire is being received. (This will not be construed as permission for indiscriminate firing into areas inhabited by non-combatants.) (Paragraph 4*a*.)

A change was introduced into the wording on 9 February 1968 (document 6) where paragraph (2) (above) was superseded by the following:

> (2) Commanders will exercise utmost care to insure minimum non-combatant casualties and property damage.

[1] HEAT = High Explosive, Anti-tank.

The regulations of 16 March 1968 (document 3) state:

Conduct of fire (*a*) Individual and crew served weapons: (1) Pistols, rifles, grenade launchers, hand grenades, claymores, machine guns, and recoilless rifles *may be employed by* commanders under the conditions indicated below:

(*a*) Against targets that are *observed and positively identified as enemy.*

(*b*) Against point targets from which fire is being received. (*Indiscriminate fire into populated areas is prohibited.*)

(*c*) *Against suspected enemy locations when non-combatants would not be endangered.*

(2) Personnel positively identified as enemy who demonstrate an intent to surrender should not be engaged by fire (Paragraph 5 (*c*); original italics).

Surface weapons

Surface weapons include artillery, mortars, tank guns, and guns fired from river patrol boats. The US Rules include separate regulations for naval artillery fired at shore-based targets.

The Rules for surface weapons are complex and to a large degree reflect specific conditions of the Viet Nam War. For example, different rules applied according to whether the target was located within a 'special strike zone' (SSZ; previously referred to as a 'free fire zone'); within an uninhabited area outside an SSZ; within an inhabited area, defined as including 'any group of dwellings as well as established hamlets and villages that do not qualify as an urban area' (document 1, paragraph 5 (*e*)); or within an urban area. Few restrictions applied to the use of munitions in SSZs, other than a requirement to notify an appropriate 'clearance authority'. Attacks against targets in urban areas, on the other hand, were subject to a number of restrictions.

A distinction is made between 'unobserved fires' and 'observed fires'. Observed fires, in turn, may be of two kinds: they may be observed by the gunner (direct fire) or by a forward observer (observed indirect fire). A forward observer may be situated on the ground or in an overflying aircraft and in each case must be in communication with the gunner in order to report on the accuracy of the fire. In general, unobserved fire is the more indiscriminate, and direct (observed) fire the more discriminate.

Of particular interest are the 'safety ranges' specified for particular weapons to be used against targets in inhabited areas. Document 4 of 1968 states:

(*e*) Following criteria will be used against known or suspected enemy targets in areas occupied by non-combatants:

105 mm fires—no closer than 500 meters plus 4 range PEs (prob errors)

155 mm fires—no closer than 800 meters plus 4 range PEs (prob errors)

8 inch and 175 mm fires—no closer than 1 000 meters plus 4 range PEs (prob errors).

(*f*) Fires will be placed no closer than 200 meters of any main paved road. When targets are located on or near a road VT fuze[2] will be used to the maximum extent possible.

Document 5 adds an additional restriction in the case of unobserved fire: "Unobserved fires will not be fired closer than 1 000 meters to non-combatant or friendly troop locations when engaging known or suspected targets" (Paragraph 4*b* (5) (*e*)).

Document 4 states, as do several others, that "villages and hamlets . . . will not be fired upon without prior warning by leaflet and/or loudspeaker systems or by other means, even though fire is received from them" (Paragraph 4*b* (5) (*b*)). However, this paragraph is followed by another which significantly modifies its effect: "(*c*) Villages and hamlets may be attacked without prior warning if the attack is in conjunction with a ground operation involving maneuver of ground forces through the area, and if in the judgement of the ground commander, his mission would be jeopardized by such warning as specified in (*b*) above."

Air-delivered weapons

Similar restrictions were applied to air attacks by fixed-wing and rotary aircraft. Thus document 1, annex 2, states, for example:

Air attacks directed against urban areas must always be controlled by FAC . . . [3]

Prior to subjecting urban area to an air attack, even when fire is being received from the area, the inhabitants must be warned by leaflets, loudspeakers, or other appropriate means prior to the attack and given sufficient time to evacuate the area (Paragraph 2 (*i*) (3)).

However, two important exceptions were made to this policy:

If the attack on an inhabited area from which enemy fire is being received is deemed necessary, and is executed in conjunction with a ground operation involving the movement of ground forces through the area, and if in the judgement of the battalion or higher commander his mission would be jeopardized by prior warning, the attack may be made without such warning or delay (Paragraph 2 (*h*) (1)).

Further, "An exception may be made for herbicide missions in cases where prior warning may jeopardize the safety of the spray aircraft" (Paragraph 2 (*h*) (2)). Additional rules for armed helicopters operated in urban areas state: "Further, only point targets, e.g. specific buildings, will be engaged and these targets must be positively identified to the pilot. The engagement of area targets in urban areas is prohibited" (Document 1, annex 3, paragraph 3 (*c*)).

[2] VT fuze = variable time fuze.
[3] FAC = Forward Air Controller.

In document 2, 7th Air Force Operations Order 71–17 (Rules of Engagement), states with regard to 'Barrel Roll East' operations in Laos:

Strikes may be conducted within 500 meters of an active village or non-combatants only when ground fire is being received from the location or when in close air support of friendly troops . . . .

No all weather strikes (except LORAN[4]) will be conducted within 3 000 meters of a known village or friendly position.

No LORAN strikes will be made closer than 1 000 meters to a known village or friendly position.

Regarding areas of cultural value in Cambodia, the same document states "Except during SAR[5] operations, no US air strikes will be made within 1 000 meters of any of the areas of cultural value (nearly 100 other [in addition to Angkor Wat] sites specifically listed in the directive)".

Naval gun-fire against land targets

Analogous rules were applied to the use of naval guns against land targets. Few restrictions were placed on such use in uninhabited areas or areas defined as 'special strike zones'. Conversely, fire in inhabited or urban areas required permission by a senior commander, control by an observer, and a warning to the population unless the fire was called for to support a ground operation already in progress.

[4] LORAN = Long Range Navigation, an electronic navigation system employing radio beacons on the ground, in this case being used as an aid to blind bombing.
[5] SAR = Search and Rescue.

Appendix 9B

Safety zones required to reduce the indiscriminate effects of conventional weapons

Table 9B.1. Safety zones for small arms with regard to military personnel in training and combat conditions[1]

Weapon	Dispersion around target (m)	Safety zone beyond target (m)
Training		
Assault rifle; Light or medium machine-gun	10	2 000–3 500
With risk of ricochet	150–200	2 000–3 500
Combat		
Assault rifle	> 3	1 400
Machine-gun	> 3	1 500

Table 9B.2. Safety zones for conventional high-explosive artillery shells with regard to military personnel in training and combat conditions

Calibre (mm)	Risk distance for fragments (f) (m)	Longitudinal dispersion (l) (m)	Horizontal dispersion (h) (m)	Safety zone, $(f + l) \times (f + h)$ (m)
Training				
75– 80	300	500	100	800 x 400
105–122	500	550	120	1 050 x 620
155	600	600	150	1 200 x 750
Combat				
75– 80	50	150	75	200 x 125
105–122	100	200	75	300 x 175
155	200	225	75	425 x 275

[1] Assumes that the target is fired upon at an average combat range of 200 m.

Table 9B.3. Safety zones for air-delivered rockets and bombs with regard to military personnel in training conditions[2]

Munition	Longitudinal dispersal of munition[3] (m)	Horizontal dispersal of munition (m)	Dispersion of fragments (m)	Required safety zone (m)
Rockets (135–150 mm)	– 1 500 + 3 000	150	600 – 1 000	4 000 x 1 000
Bombs (50 –500 kg)	– 500 + 2 000	300	800 – 1 000	3 000 x 1 100

Note: The above tables were compiled for reference [9] from Swedish military regulations.

[2] Assumes a target area of 100 x 100 m.
[3] The 'minus' figure is the risk zone in front of the target, the 'plus' figure is the risk zone behind the target.

10. Stockpiles of chemical weapons and their destruction[1]

Square-bracketed numbers, thus [1], *refer to the list of references on page 486.*

I. Introduction

Earlier SIPRI publications provide technical background information for facilitating the negotiations on a convention prohibiting the possession of chemical weapons [1–4]. This chapter will discuss some recent developments of importance in this field, particularly in the destruction of stockpiles of chemical weapons.

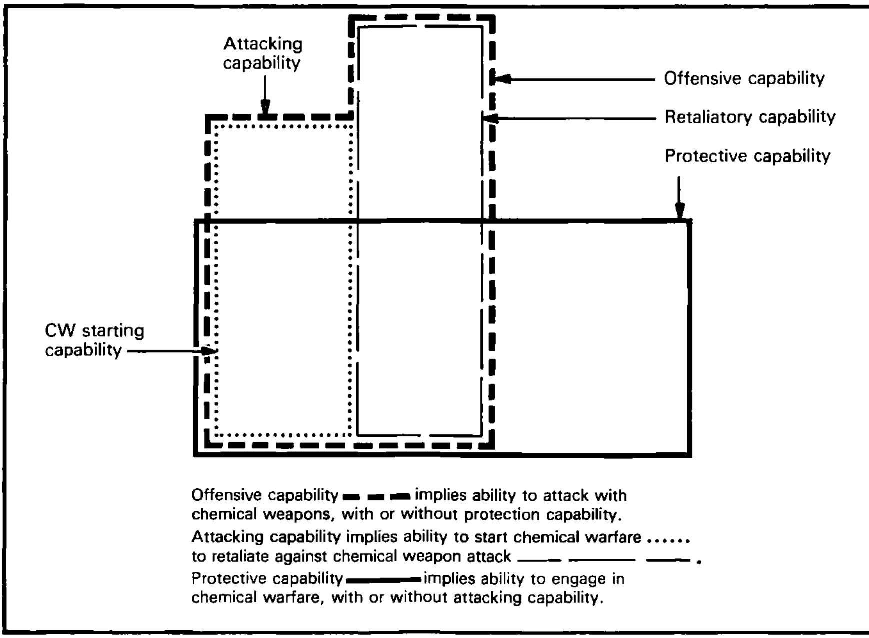
Two important considerations influenced the choice of topics in this chapter. First, the question of the destruction of chemical weapon stockpiles is closely interlinked with the conditions for the production of these weapons. Second, the problem of verification of the destruction of chemical weapons and production facilities does not seem at present to be soluble in its entirety; hence it seems more worthwhile here to concentrate instead on a few aspects.

One point largely overlooked so far is that the possession or non-possession of chemical weapon stockpiles is not the sole decisive factor for a country planning to maintain or to acquire a militarily important chemical warfare (CW) capability. This fact acquires importance in the light of the growing signs indicating that chemical weapons increasingly seem to be regarded as useful tactical weapons in specific situations [5–17]. A reminder of the existence of the long-term threat of chemical warfare in Europe came at the time of the Arab–Israeli conflict of October 1973, when Soviet equipment supplied to the Egyptian forces was seen to be well provided with anti-CW protection [18].

In the long run, the factors that are decisive in creating a CW capability (see figure 10.1) are (*a*) planning, (*b*) organization, and (*c*) training of military forces (see table 10.1). For a country to attain a militarily important offensive CW capability, planning has to start several years in advance. The country concerned has to make adequate provision for research and development, for organization and training, and finally for deployment of chemical weapons. The training, initially applying to officers in higher staffs, has to cover both offensive and protective aims (see figure 10.1). The acquisition of chemical weapons

[1] Since the author is a Swedish civil servant, it is necessary to state that the opinions expressed in this chapter are his alone and do not necessarily reflect the views of the Swedish government or other Swedish authorities.

Figure 10.1. Relations between concepts concerning a chemical warfare capability



does not need to take place until relatively late in the sequence, provided that adequate plans have been made in advance. The option is open of using industrial bulk chemicals in an emergency. After such a level of preparedness has been attained, an offensive CW capability can be maintained by adequate training mainly, but not exclusively, for protective purposes—which would be allowed under a chemical weapon convention. In order to abolish this veiled long-term threat, a convention would need also to cover activities directed towards preparing for offensive chemical warfare; simply destroying existing chemical weapon stockpiles is not enough.

The question then arises: Is there any possibility of distinguishing between offensive and protective training? Although verification of these activities is difficult, it is nevertheless considered possible in certain circumstances [20]. Table 10.2 suggests some items for observation by trained observers having access to manoeuvres and similar activities carried on by parties to a convention. Figure 10.2 outlines the observations for tell-tale signs which could be made at sensitive sites where equipment and chemical munitions for, say, artillery and aircraft might be stockpiled and transported. In contrast to many other verification methods, these observed signs indicating a CW capability would be revealing and would be very difficult to explain away.

Table 10.1. Examples of time-scale for preparation of a qualified CW capability

Year(s)	Technique	Staff preparations	Logistics
. . .		Decision	
. . .	Development	Strategy	
– 7	Munition testing	Tactics	
– 6			
– 5	Production		Transportation directions, etc.
– 4		Training preparations	
– 3			
– 2		Training	Training
– 1			
– ½			Munition distribution
0		Chemical weapons ready for use	

'Visibility line' = the approximate point on the time-scale when a certain activity generally cannot be kept secret any longer

Source: Reference [19].

Table 10.2. Important items tentatively to be looked for by an observer in monitoring compliance with a convention on chemical weapons which also prohibits planning, organization and training for attaining an offensive CW capability

Military activities	Civil defence activities
Military protective posture	Civil defence posture
Materials and equipment	Materials and equipment
General military equipment	General instruction and training
Offensive equipment	Staff functions, e.g., alarm systems
Maintenance	Special units
Preparedness	
Staff training	
Unit training	
Special units	

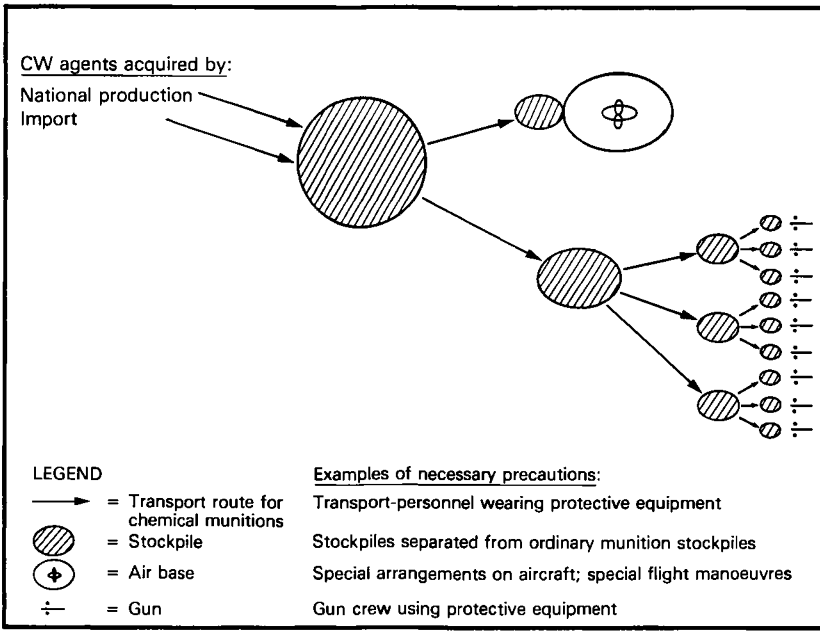
Note: See also reference [20].

II. Objectives of destroying chemical weapon stockpiles

General

One of the important problems in the present discussions in the Committee on Disarmament (CD) in Geneva is the question of the

Figure 10.2. Identification of sensitive sites where chemical munitions are stockpiled and transported



Source: Modified from reference [21].

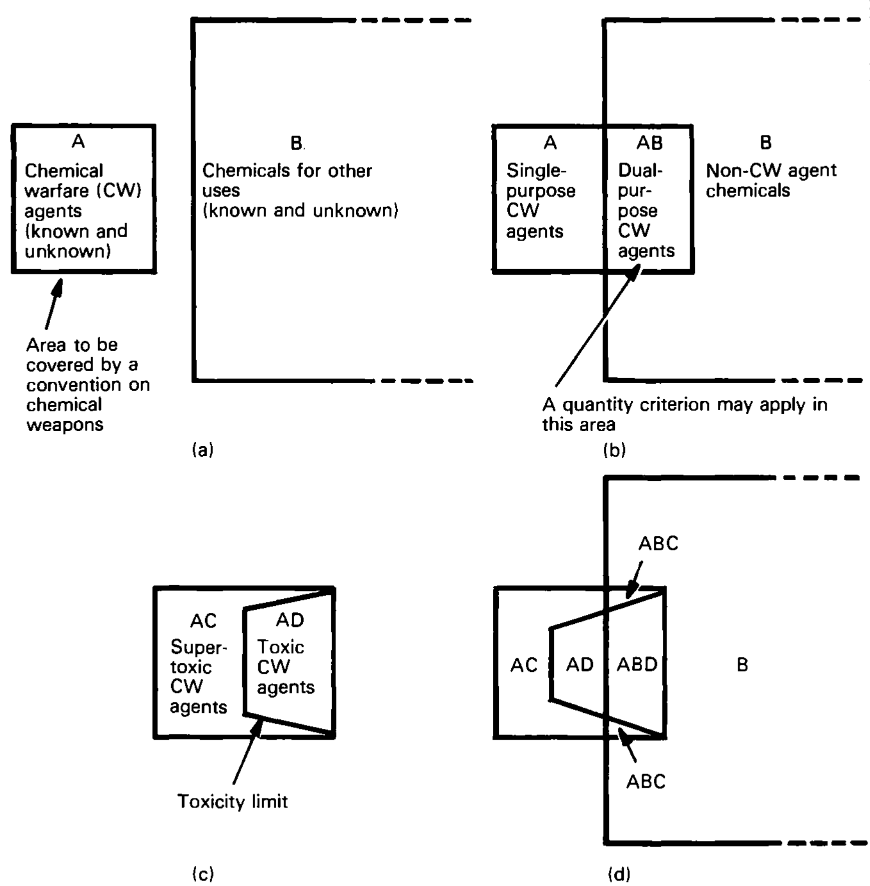
destruction of chemical weapon stockpiles and production facilities, and the verification of such destruction. This also seems to have been the case in the bilateral talks between the USA and the USSR [22]. This problem is discussed here with particular reference to the USA and the USSR and to the European situation.

If an agreement is reached on the destruction of chemical weapon stockpiles—including those which may not be publicly known today—a significant and real disarmament measure will have been achieved. Such an agreement would also be important from the point of view of immediate preparedness to wage chemical warfare; that is, once the stockpiles have been eliminated, the capacity for starting a chemical war at short notice would have diminished in some respects. However, where chemicals less toxic than the most toxic CW agents (the nerve agents) are concerned, a certain capacity would remain. The reason for this is that highly toxic chemical substances which are manufactured for ordinary chemical industrial purposes may also, in certain circumstances, be useful as CW agents (see figure 10.3).

Some countries—the USA at any rate—may have such large stockpiles of chemical weapons that it will take many years to destroy them. This interval constitutes a period of uncertainty and insecurity before and during a convention, especially in Europe.

One complicating issue with regard to the destruction of chemical

Figure 10.3. Relations between different types of chemicals to be covered or not covered by a convention prohibiting the development, production and stockpiling of chemical agents



(a) This represents the simple case where all CW agents can easily be defined and prohibited by a chemical weapon convention (A) and all other chemicals be unregulated (B). This case does not exist. B is left open so as to emphasize the very much larger number of chemicals in this category compared with A.

(b) The first important complication is that some chemicals can be used both for warfare and for peace-time purposes (AB). A convention must apply a purpose criterion prohibiting the development, production and stockpiling of chemicals with the intention of using them as CW agents. The amounts of dual-purpose agents that may be produced may be regulated by a quantity criterion.

(c) A toxicity limit (one of several) may be introduced in order to define chemicals, the development, production and stockpiling of which shall always be prohibited (AC), and those which may be developed, produced and stockpiled even if they are dual-purpose CW agents.

(d) Consequences of introducing a toxicity limit into the model in (b): some supertoxic substances may have peace-time uses (ABC) but may still have to be prohibited owing to their high toxicity; other concepts may also have to be considered, e.g., properties making chemicals useful as CW agents.

Source: Modified from reference [23].

weapons is that they are not designed with the aspect of their future destruction uppermost in mind. The simple line of thinking all along has probably been that munitions, if not used up, can always be disposed of by dumping in the sea or burying in the earth [24]. The growing public concern about the environment and natural resources could not readily have been perceived some 20–30 years ago, and this trend has placed severe restrictions on the means available for destroying chemical weapons and CW agents.

The destruction of production facilities is somewhat less critical for an immediate CW capability than the destruction of the CW agents. However, in order to hinder the revival of an advanced CW capability, such facilities have to be destroyed or securely sealed, and in the latter case the seals have to be monitored. It can be argued that new production facilities might be built clandestinely in some other place. This presents yet another difficult verification problem in the drafting of a chemical weapon convention. However, in the opinion of some prospective parties to a convention, this possibility of evasion should not lead to any relaxation in vigilance in respect of existing facilities, which might otherwise be capable of producing CW agents at relatively short notice [25].

Chemical weapon stockpiles and CW agent bulk stockpiles

Unfortunately, information is available only from the USA on existing stockpiles, on their condition, and on the practical means for their destruction. Accordingly, the discussion in this chapter is strictly applicable only to conditions prevailing in the USA. However, the main considerations may be applied to any other country that may have a CW capability at present, even if conditions in that country differ markedly from those in the USA. As regards the destruction of old stockpiles of chemical weapons, some information is available also from countries other than the USA [26].

The types of munition that are now being destroyed or have previously been destroyed in the USA fall into the *unserviceable* or *obsolete* category. Unserviceable munitions are considered to be no longer usable, for example, owing to leakage or to corrosion that has progressed so far as to make continued stockpiling or transport hazardous. Obsolete munitions are those which no longer fit any weapon system in use, and hence have to be destroyed even if they are in perfect condition. The USA also possesses stockpiles of CW agents in bulk containers (large drums, so-called ton containers, having an agent content of about 700 kg). In some cases at least, the stockpiles consist of several thousand small mounds, well separated from each other and containing munitions or drums [27].

Production and stockpiling of industrial chemicals

So long as production concerns single-purpose CW agents, such as the nerve gases, the first option would probably be to build a special plant for their manufacture. This was the case in the USA, where, for example, plants were built for the production of sarin in the 1950s and for VX in the 1960s. In view of the hazards involved, it seems unlikely that highly toxic agents, such as the nerve gases, would be produced within large multi-purpose production facilities. However, it might be argued that other more isolated facilities for the production of, say, organophosphorus insecticides—which are related to the nerve gases, in some cases even in toxicity—might also be equipped for the production of nerve gases. Again, this seems rather unlikely, and in many countries it would be difficult to conceal.

Organophosphorus insecticides are, of course, not the only toxic compounds produced by the chemical industry. For example, phosgene —today produced in large amounts in the plastics industry—was considered a dangerous CW agent during World War II. Stockpiles of such substances have to be maintained for normal industrial requirements, and they may amount from several tonnes to several thousands of tonnes. A chemical weapon convention cannot possibly prescribe that such industrial stockpiles be destroyed. Stockpiles of certain substances may be kept small in some cases because of safety considerations. This need not imply that the volume of production is small. The substances, being intermediates in chemical processes, may be used up rapidly; the stockpiles merely serve as buffer reserves.

Notwithstanding the fact that the likelihood of production of the more toxic CW agents in civilian facilities is small, one source maintains that in the USSR the production of CW agents takes place under civilian authority [28]. It is, of course, impossible to assess the reliability of this assertion until official information is forthcoming from the Soviet Union. It has often been pointed out during the disarmament talks that the chemical industry would not produce CW agents clandestinely on its own initiative. If it does produce single-purpose CW agents, it is more likely acting at the behest of the respective national government.

The possibility cannot be ignored that toxic dual-purpose chemicals are being bought and sold and transferred between countries for the purpose of serving a CW capability. Depending on the conditions prevailing in the purchasing country, even substances routinely used in industrialized countries may effectively be used in chemical warfare.

The maintenance of ageing stockpiles of chemical weapons in the vicinity of densely populated and heavily trafficked areas is associated with environmental hazards. Further hazards are associated with the handling and transport of chemical weapons. These hazards have engendered strong domestic resistance in the USA against the presence and relocation of chemical weapon stockpiles in the country. These and other reasons have led—at any rate in the USA—to the development of binary chemical weapons.[2] Their design obviates, in certain respects, the environmental, storage and transportation risks associated with conventional nerve-gas munitions, but this advantage is gained at the expense of some efficiency in use [2b].

It was at first thought that binary chemical weapons would complicate the formulation of the scope of a convention on chemical weapons. However, now it seems generally agreed that production and other features of the binary components will be covered by the so-called purpose criterion[3] (see figure 10.3). Even so, the binary compounds—just like some dual-purpose chemicals—cause difficulties of verification, since at least one of them required for producing a nerve gas appears to have legitimate peace-time use, and must accordingly be allowed to be produced in sufficient amounts, which could be drawn upon for warfare purposes if the need arose. Further, the relatively low toxicity of each of the two components as compared with the end-product—a nerve gas—would make it easier to evade those parts in a conceivable future verification scheme that are based upon looking out for the presence of some military safety precautions [29]. See also figure 10.2.

III. Methods for destroying CW agents and chemical weapons

General

Possible destruction methods have already been summarized by SIPRI [2d, 30a]. Several working papers on the subject have been presented in the CCD [26, 31–33]. The methods are listed in table 10.3 and are briefly discussed in the next two subsections.

The methods for disposing of production facilities, for demolishing

[2] In a binary chemical weapon, two fairly non-toxic chemical components are placed separately. When the munition is fired, the components are made to mix. This starts a fast chemical reaction which results in the formation of the toxic CW agent, for example, a nerve gas, which is delivered on arrival at the target. The binary reaction principle also has wide civilian applications. The mixing of two components to form a hardened epoxy adhesive is one simple example of this kind. For an extensive discussion, see reference [2a].

[3] The purpose criterion—likely to be applied in a future convention on chemical weapons—would state that even the production of chemical substances normally used for peaceful purposes would be prohibited if such production were carried out with the intention of using the substances for chemical warfare. See figure 10.3.

Table 10.3. Methods for the destruction of chemical warfare agents

Thermal cleavage			Chemical cleavage		
Method	Appropriate agent(s) for destruction	Comments	Method	Appropriate agent(s) for destruction	Comments
Pyrolysis: Heating to 200–500°C in the absence of air	All	Lack of experience; dangerous end-products sometimes obtained	*Hydrolysis:* in alkaline aqueous solution	Sarin Soman	End product: dry salts
Incineration: Burning in the presence of air and fuel oil	Mustards Lewisite		*Hydrolysis:* directly with caustic soda	VX	End-product: dry salts
			Oxidative chlorination: Treatment with aqueous solution of chlorine-containing compounds	All	Useful for decontamination of persons, soil, structures, especially when small amounts of CW agent are treated
			Other methods: Water–alcohol solutions of sulphides containing emulsifiers	Tear-gases	For large-scale destruction

Source: Reference [30a].

them, for rebuilding them for other types of production, or for putting them on stand-by by sealing them off are not described in detail here. CW agents and production facilities may also be converted to other substances and put to other uses, respectively.

National and international legislation places further restrictions on the stockpiling, transport and destruction of hazardous chemical substances. Thus, the former practice of dumping CW agents (mustard gas and nerve agents) in the sea has had to be discontinued [34]. International regulations governing the burning of chemicals out at sea are now also being drawn up [35].

One way of complying with the legislative restrictions is the construction of a mobile destruction plant, this being transported in turn to each of the various stockpile locations. This procedure would, on the other hand, add greatly to the cost of destruction. It has been investigated in the USA [36a].

Principal methods and costs of destruction

The chief methods for the disposal of CW agents are (*a*) geographical relocation, (*b*) thermal decomposition, and (*c*) chemical decomposition.

Applications of these methods are given in the next subsection. Methods (*b*) and (*c*) are summarized in table 10.3.

The method selected in any particular case depends on the numbers of munitions and the amounts of CW agents to be destroyed. The time required for destruction has also to be taken into consideration. For countries having sizeable stockpiles of CW agents, the cost of destruction may be substantial. These two factors are important in drawing up a convention on chemical weapons. If destruction costs are to be kept within reasonable limits, it is clear that many years of destruction work will be required. It was calculated in 1974 that the existing US stockpiles of CW agents represented a book value of about $215 million and that the cost of destroying them would come to about $750 million [2e]. This cost has perhaps more than doubled since then.

After World War II, mustard gas was burned in large quantities on land [30b]. Large quantities were also dumped in the Baltic and the North Seas. These dumpings are still a cause of concern to fishermen in the southern Baltic. There have been frequent reports of dumped mustard-gas canisters and munitions brought up in the nets. Injuries have been reported in some of these cases.

During the 1960s and until 1969, nerve agents were dumped out at sea off the east coast of the United States. As part of a larger programme, leaking munitions—most of them containing sarin, but some containing VX—placed in concrete castings were dumped in the ocean. This evoked public protests. These protests forced the US authorities to look for other means of disposal. They also had to contend with US legislation governing the overland transport of dangerous chemicals, including CW agents. It became virtually impossible to move unserviceable or obsolete stockpiles at Rocky Mountain Arsenal near Denver, Colorado, without special permission. The intention was to move these stockpiles to the large stockpiling area at Tooele, Utah, where safety hazards were much less. Transport of some agents seems to have been undertaken since then for the purpose of destruction with environmental safeguards and full public disclosure in accordance with US public law [37].

A destruction facility constructed at Rocky Mountain Arsenal started work on the local stockpiles in 1971. It ceased operating in 1977 after 2 800 tonnes of mustard gas in bulk storage vessels and 1 900 tonnes of the nerve agent sarin in 21 000 bombs had been destroyed over a period of about seven years [38a].

The experience gained at Rocky Mountain Arsenal was applied to the subsequent task of destroying unserviceable stockpiles at the Tooele base in Utah, where stationary destruction facilities were constructed. Some technical details of the process have already been discussed [30c].

The CAMDS[4] destruction facility at Tooele Army Depot, Utah, USA [36b, 39][5]

There are several reasons for describing the Tooele destruction facility. First, it is a fair-sized plant, built to test procedures for the 'demilitarization' of various kinds of chemical weapons and to serve as a pilot plant. Second, it was built to stringent environmental specifications. Third, it was visited by the Pugwash CW Workshop[6] at the invitation of the US Army [38b]. The invitation and visit serve as an example of confidence-building measures (CBMs) discussed below.

The visit by the Pugwash CW Workshop was part of the group's endeavours to find possible means for verification and CBMs of value for reaching a convention on chemical weapons.[7] The visiting group obtained a greatly improved understanding of the problems involved in adequate destruction of nerve-gas and mustard-gas stockpiles.

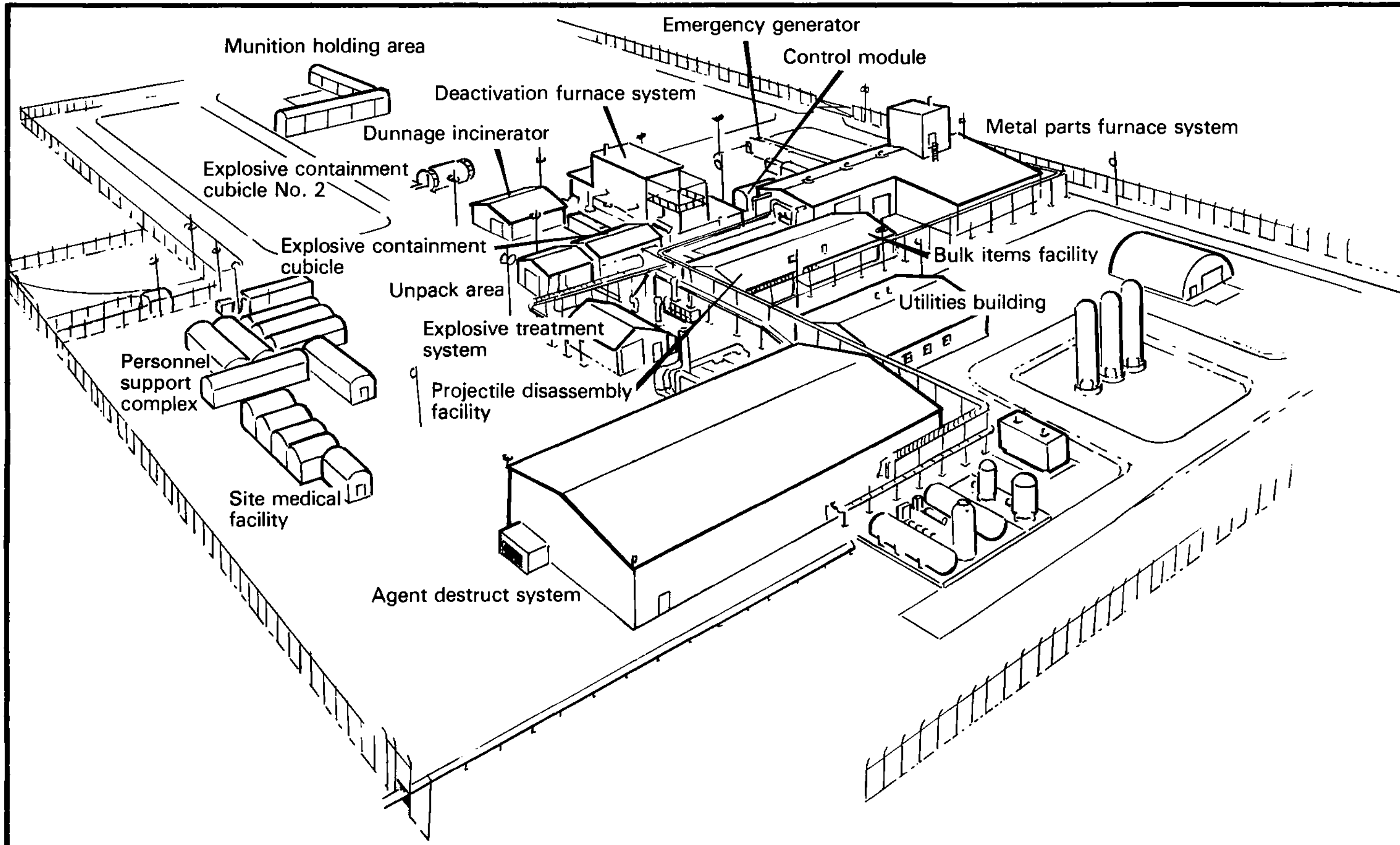
The purpose of CAMDS is to try out various destruction procedures in test runs and also to dispose of unserviceable and some serviceable lethal chemical material now stored at Tooele Army Depot. Construction started in 1971 and the facility was planned to commence destruction at the end of 1978. The facility is situated some 24 km from the Tooele Army base south-west of Salt Lake City, Utah. The plant covers about 4 ha and is located adjacent to large areas for stockpiling munitions and CW agents in bulk. The Tooele South Area covers nearly 4 000 ha overall.

The 'demilitarization' process involves dismantling the munitions and destroying the CW agents by burning (mustard gas), hydrolysis in sodium hydroxide solution (sarin) and chlorinolysis (VX). These destruction processes are carried out in different buildings (see figure 10.4). The processes are carried out under extreme safety measures and are to a great extent remotely controlled. The dismantling of the munitions (see figure 10.5) is handled in secluded areas under negative atmospheric pressure. Workers entering the area where these activities are carried out have to be clad in safety suits, which are hermetically sealed and impervious to CW agents. These protective suits are equipped with communication systems. The workers are electronically monitored constantly by personnel outside the danger area who can follow the progress of the work through special viewing ports.

Perimeter monitoring of air and water is performed continuously so

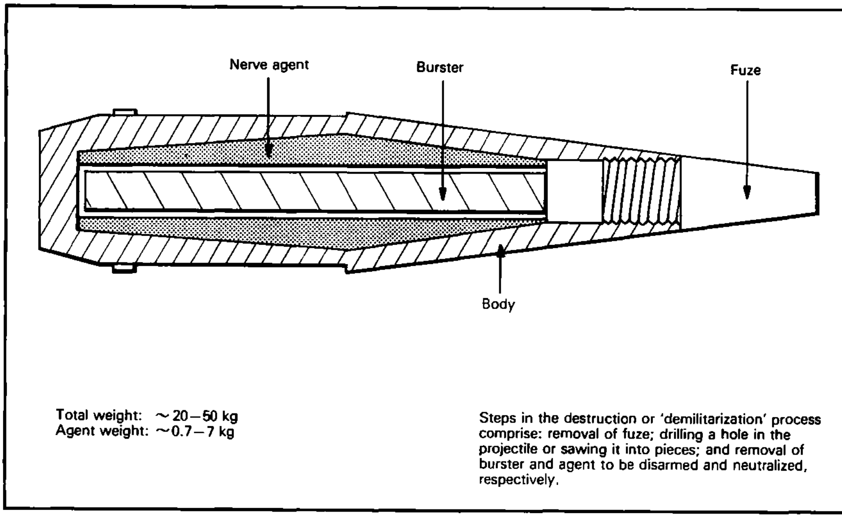
[4] CAMDS = Chemical Agent Munitions Disposal System.
[5] Factual information in this subsection is taken from reference [36b] unless otherwise stated.
[6] In 1974 Pugwash set up a workshop for chemical disarmament matters.
[7] The group is international. Normally, most of its members come from the Eastern and Western blocs, but on the occasion of the CAMDS visit the composition of the group was not balanced in this respect [38b].

Figure 10.4. Sketch of site of the Chemical Agent Munitions Disposal System (CAMDS), Tooele, Utah, USA



Source: Reference [36c].

Figure 10.5. Main features of a projectile for a nerve agent



Source: Modified from reference [36d].

as to fulfil the safety requirements prescribed by the environmental authorities. The emissions from the burning pass through scrubbers and filters before being released into the atmosphere. The chemical processes result in the formation of various salts. The total amount of these salts formed during the testing period is calculated to be about 1 000 tonnes. The salts are classified as less than Class B poisons according to US standards.

The overall test programme concerns about 610 tonnes of CW agents over a period of nearly seven years (see table 10.4). It will employ about 240 specialized workers. The cost for the construction of CAMDS and for its operation over the testing period is calculated to be over $125 million.

The USA has had to expend great skill and technical effort in destroying large amounts of CW agents at Rocky Mountain Arsenal and Tooele Army Depot. Skills and resources of the kind required are likely to be in short supply. This factor will have to be taken into consideration in a convention prescribing the destruction of chemical weapon stockpiles, especially if several other countries declare stocks for destruction. It would probably be of practical benefit if the parties concerned were to pool their resources, even if the details of the destruction work might vary from country to country owing to differences in munitions and agent compositions.

Table 10.4. Munitions to be destroyed by the Chemical Agent Munitions Disposal System (CAMDS) at Tooele Army Depot, Utah, USA

Types of munition	Agent	Approximate weight of agent (tonnes)		Scheduled time for destruction (months)
Projectiles Rockets Bombs	GB	240		40
Projectiles Mortars 'Ton containers'	H, HD	335		30
Projectiles Land-mines 'Ton containers'	VX	35		10
Total number of munitions to be 'demilitarized' ~126 000	**Total weight of agent**	**610**	**Total time**	**80**

Source: Calculated from information given in reference [36b].

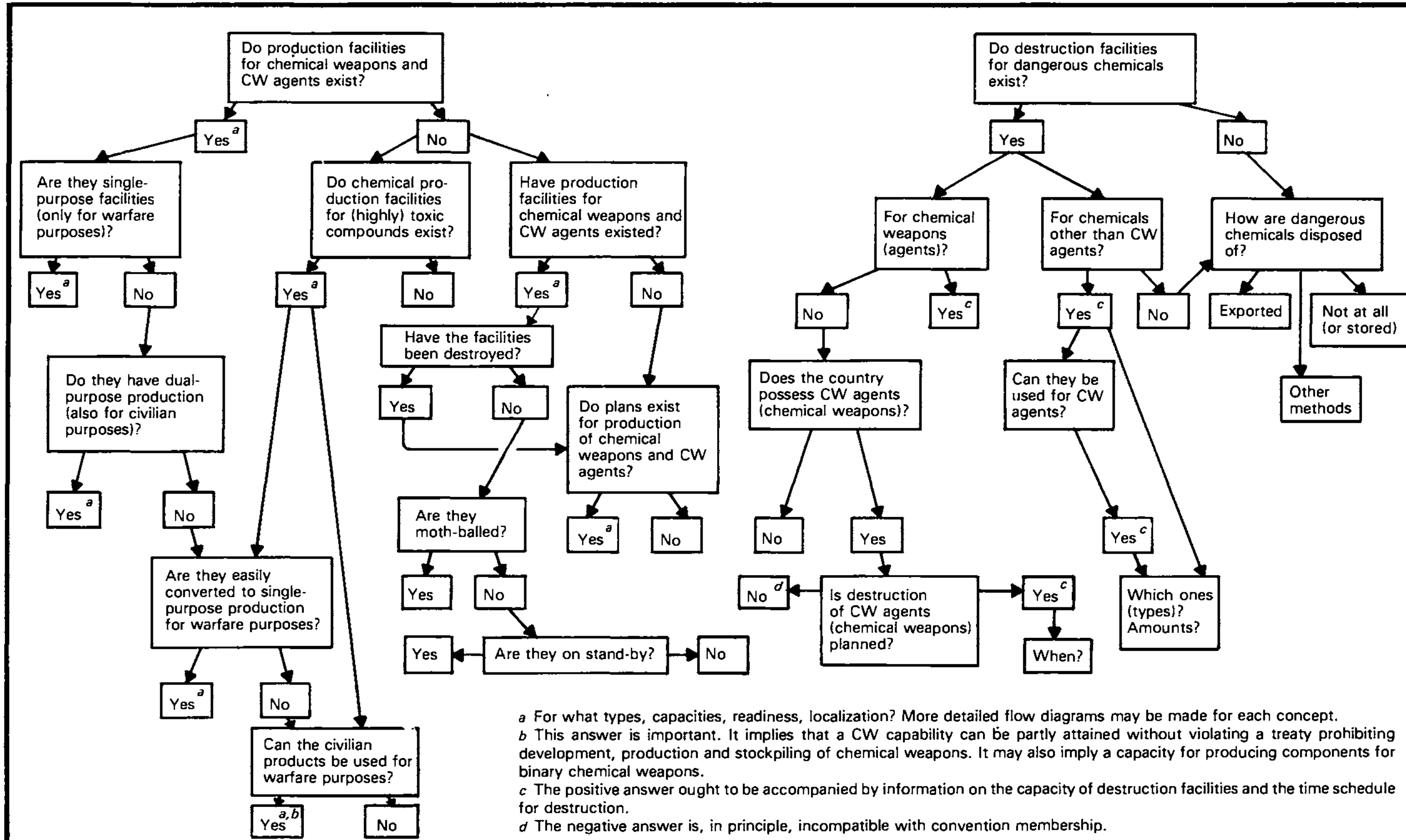
VI. Verification of destruction

Information on production facilities and stockpiles

Information on the status of production facilities, stockpiles and munition destruction will conceivably have to be provided by chemical weapon possessors to all parties to a convention. This information may be made available through declarations by the parties to a convention or even by prospective parties before a convention comes into force. This course is suggested, for example, in the British draft convention on chemical weapons [40]. Information may also be obtained by intrusive or non-intrusive international verification methods. It has also been suggested that national organizations in a country should provide information on a national basis about possible production and stockpiling activities and monitor the provisions of a convention [4a, 41]; the possibility of using additional supervision procedures, especially with regard to the verification of stockpile destruction, has also been put forward [42]. In fact, the USA and the USSR have agreed bilaterally that verification shall be based on national plus some international measures [22].

The fact that unilaterally provided information, not subjected to particular international verification measures, is tantamount only to CBMs does not diminish its political significance. CBMs in this context are not limited to those formally introduced, for instance, by the Helsinki Accord [43], but comprise any measure undertaken or any

Figure 10.6. Matters regarding chemical weapon production and CW agent destruction which may tentatively be declared or be accounted for by states for confidence-building purposes before adhering to a chemical weapon convention or as parties to it



a For what types, capacities, readiness, localization? More detailed flow diagrams may be made for each concept.

b This answer is important. It implies that a CW capability can be partly attained without violating a treaty prohibiting development, production and stockpiling of chemical weapons. It may also imply a capacity for producing components for binary chemical weapons.

c The positive answer ought to be accompanied by information on the capacity of destruction facilities and the time schedule for destruction.

d The negative answer is, in principle, incompatible with convention membership.

Source: Modified from reference [45].

information provided unilaterally by a state to increase confidence in it on the part of other states. Similar reasoning has been advanced in another connection, namely, the question of arms control in age characterized by technological change [44].

Figure 10.6 shows what information it might be necessary to provide in connection with the production or destruction of CW agents and chemical weapons. A diagram of this kind serves to structure discussions on CBMs and to delimit them from the necessary verification measures. However, for a declaratory purpose, the analyses need not go into the detail previously suggested with regard to the verification of stockpile destruction and to the phosphorus accounting system intended as a verification method for the non-production of nerve gases [2f, 4b, 46–47].

The question has been raised in the CCD of how allegedly concealed or undeclared stockpiles and production facilities should be traced where trust is lacking or where mistrust arises as to the intentions of a party to the convention. The complications grow in cases where the facilities searched for do not in fact exist, even though so-called verification by challenge might ease such a situation.

Verification of stockpile destruction

Verification of stockpile destruction can clearly be performed so long as on-site presence is allowed. This is one of the conclusions to be drawn from the visit paid by the Pugwash CW Workshop to CAMDS [38c]. Conversely, verification possibilities diminish with diminishing access or information. However, some confidence may be generated if blind samples may be taken from the material to be destroyed and subjected to regulated analytical methods [48]. Analytical physical and chemical methods would increase in efficiency the nearer they could be applied to the destruction site and process. If perimeter samples could be taken and the emissions monitored continuously, the chances would be good for stating what types of chemical substance were being destroyed in the facility, even if restrictions for environmental purposes had necessitated stringent emission controls within the facility [49].

Objections have been raised about the risks of disclosure of chemical processes or patented processes, possibly leading either to proliferation of chemical weapon technology or to infringements of patent rights to the detriment of the party so disclosed [50]. The Pugwash group concluded that the CAMDS visit had not led to the disclosure of any information of importance for the possible proliferation of chemical weapons [38c].

Remote sensing methods, other than possibly photoreconnaissance, operating from satellites would probably be ineffective. Satellite photo-reconnaissance would probably only be able to show that activity was afoot at some declared facility, but nothing more. In any event, as long as satellite monitoring is possible only for the USA and the USSR, it cannot be of any help to the majority of other states. However, the suggestion on an International Satellite Monitoring Agency made by France to the 1978 UN General Assembly Special Session Devoted to Disarmament may indicate an incipient change in this respect [51].

References

1. *The Problem of Chemical and Biological Warfare*, 6 volumes (Almqvist & Wiksell, Stockholm, 1971–1975, Stockholm International Peace Research Institute).
2. *Chemical Disarmament: New Weapons for Old* (Almqvist & Wiksell, Stockholm, 1975, Stockholm International Peace Research Institute).
   (a) —, pp. 21–74, 94–99.
   (b) —, p. 54.
   (c) —, p. 94.
   (d) —, pp. 102–13.
   (e) —, p. 46.
   (f) —, pp. 114–24.
3. 'Possible techniques for inspection of production of organophosphorus compounds', SIPRI Symposium Report, Stockholm International Peace Research Institute, 1971, mimeographed.
4. *Chemical Disarmament: Some Problems of Verification* (Almqvist & Wiksell, Stockholm, 1973, Stockholm International Peace Research Institute).
   (a) —, pp. 36–50.
   (b) —, pp. 51–130.
5. Bay, C. H., 'Chemical warfare and the military balance', *Parameters,* Vol. 7, No. 2, pp. 39–53.
6. Nerlich, U., 'Die Bedeutung chemischer Kampfmittel für die Verteidigungskonzeption 1980–90 aus der Sicht der Bundesrepublik Deutschland', *Europäische Wehrkunde*, Vol. 26, No. 7, July 1977, pp. 337–43.
7. Marriott, J., 'Chemical warfare', *NATO's Fifteen Nations*, Vol. 22, No. 3, June 1977, pp. 53–65.
8. Douglass, J. D., Jr., 'Soviet nuclear strategy in Europe: A selective targeting doctrine?' *Strategic Review*, Fall 1977.
9. Carpenter, W. M., Berning, W. W., Chamberlin, J. L., Dornan, J. E., Jr., DuBois, E. L., Gibert, S. P. and Zuehlke, A. A., Jr., *Evaluation of Chemical Warfare Policy Alternatives—1980–1990*, Prepared for the Office of the Assistant Secretary of Defense, International Security Affairs, The Pentagon, Washington, D.C. (Stanford Research Institute, February 1977).

10. Rühle, H., 'Chemische Waffen und europäische Sicherheit 1980–1990', *Europäische Wehrkunde,* Vol. 27, No. 1, January 1978, pp. 5–10.
11. 'Warsaw Pact chemical warfare effort cited', *Aviation Week,* 20 February 1978, p. 16.
12. Binder, D., 'US re-emphasizing chemical warfare', *New York Times,* 5 June 1978.
13. Meselson, M., ed., *Chemical Weapons and Chemical Arms Control,* Papers and Discussion from a Conference at the American Academy of Arts and Sciences, Boston, Massachusetts, January 21–22, 1977 (Carnegie Endowment for International Peace, 1978).
14. Hoeber, A., and Douglass, J. D., Jr., 'The neglected threat of chemical warfare', *International Security,* Vol. 3, No. 1, Summer 1978, pp. 55–82.
15. *New York Times,* 13 September 1978, p. 8.
16. Foley, J., 'Russia steps up chemical warfare manoeuvres', *Bangkok Post,* 15 September 1978, p. 5.
17. Perry Robinson, J. P., 'The special case of chemical and biological weapons', *Bulletin of the Atomic Scientists,* Vol. 31, No. 5, 1975, pp. 17–23.
18. 'Chemical arms efforts stepped up, US is responding to signs of Soviet nerve gas readiness', *Baltimore Sun,* 12 December 1976.
19. The Research Institute of the Swedish National Defence, Working Paper, FOA 4, 1978.
20. Pittaway, A. R., *Prepared Statement in US Chemical Warfare Policy,* Hearings before the Subcommittee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs, House of Representatives, 93rd Congress (US Government Printing Office, Washington, D.C., June 1974), Serial No. 33–749, p. 79.
21. Jacksén, S., *C-krig: Faktorer som påverkar den internationella hotbilden,* Försvar i Nutid, No. 5, 1974 (Centralförbundet Folk och Försvar, Stockholm).
22. USSR, Disarmament Conference document CCD/PV.788, 9 May 1978.
23. Lundin, J., 'Description of a model for delimitating chemical warfare agents in an international treaty', *FOA Reports,* Vol. 9, No. 4, June 1975 (Research Institute of Swedish National Defence, Stockholm), pp. 1–10.
24. *International Herald Tribune,* 10 August 1970.
25. USA, Disarmament Conference document CCD/PV.702, 13 April 1976, p. 12.
26. Canada, Disarmament Conference document CCD/434, 16 July 1974.
27. Didion, J., 'On the last frontier with VX and GB', *Life,* 16 March 1970.
28. Agursky, M., *The Research Institute of Machine-Building Technology* (in Russian), Soviet Institution Series, Paper No. 8 (The Soviet and East European Research Center, The Hebrew University of Jerusalem, 1976).
29. *Department of Defense Appropriations for 1976,* Hearings before a Subcommittee of the House Committee on Appropriations (US Government Printing Office, Washington, D.C., 1975), Part 9, p. 257.

30. *World Armaments and Disarmament, SIPRI Yearbook 1978* (Taylor & Francis Ltd, London, 1978, Stockholm International Peace Research Institute).
    (a) —, pp. 360–76.
    (b) —, p. 364.
    (c) —, p. 370.
31. Sweden, Disarmament Conference Document CCD/324, 30 March 1971.
32. USA, Disarmament Conference Document CCD/367, 20 June 1972.
33. USA, Disarmament Conference document CCD/436, 16 July 1974.
34. *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* (Inter-governmental Maritime Consultative Organization, London, 1976), Article IV and Annex I.
35. *Report of the Third Consultative Meeting, LDC III/12* (Inter-governmental Maritime Consultative Organization, London, 24 October 1978).
36. *Operation of the Chemical Agent Munitions Disposal System (CAMDS) at Tooele Army Depot, Utah*, Final Environmental Impact Statement (US Department of the Army, Office of the Project Manager for Chemical Demilitarization and Installation Restoration, March 1977).
    (a) —, p. 2.
    (b) —, plus enclosures.
    (c) —, p. 9.
    (d) —, Enclosure No. 1, Munition Description.
37. '2 Shipments of poison gas will be moved by Army', *New York Times*, 11 December 1976, p. 10.
38. Pugwash Newsletter, Vol. 16, No. 1, July 1978.
    (a) —, p. 11.
    (b) —, p. 4.
    (c) —, p. 7.
39. USA, Disarmament Conference document CCD/436, 16 July 1974.
40. United Kingdom of Great Britain and Northern Ireland, Disarmament Conference document CCD/512, 6 August 1976, Article II, 1a–1d, pp. 2–3.
41. Bulgaria, Czechoslovakia, Hungary, Mongolia, Poland, Romania, USSR, Disarmament Conference document CCD/403, 28 June 1973.
42. USSR, Disarmament Conference document CCD/522, 15 February 1977, p. 9.
43. Document on confidence-building measures and certain aspects of security and disarmament, included in the Final Act of the Conference on Security and Co-operation in Europe, in *Konferensen om säkerhet och samarbete i Europa 1973–1975* [Conference on Security and Co-operation in Europe 1973–1975], New series II:29 (Swedish Foreign Office, Stockholm, 1975).
44. *Strategic Survey 1975* (International Institute for Strategic Studies, London, 1976), p. 116.
45. Lundin, S. J., 'The lingering CW–convention', Paper presented at the 28th Pugwash Conference, Varna, Bulgaria, 1–5 September 1978.
46. Midwest Research Institute, *The Role of Phosphorus Control in*

Verification of a Ban on Nerve Gas Agent Production: An Economic and Technical Analysis, Vol. I and II, Prepared for US Arms Control and Disarmament Agency, January 1973.
47. USA, Disarmament Conference document CCD/437, 16 July 1974.
48. Sweden, Disarmament Conference document CCD/485, 5 April 1976.
49. 'Chemical and instrumental verification of organophosphorus warfare agents', Report prepared for the Ministry for Foreign Affairs of Finland by the Advisory Board for Disarmament (Helsinki, 1977), p. 2.
50. USSR, Disarmament Conference document CCD/PV.647, 30 July 1974, p. 18.
51. Memorandum from France concerning the establishment of an International Monitoring Agency (A/S-10/AC.1/7), in United General Assembly document A/S-10/23 (Part II), 30 June 1978, p. 28.

11. The UN Special Session on Disarmament: an analytical review

Square-bracketed numbers, thus [1], refer to the list of references on page 520.

I. Introduction

At the initiative of the non-aligned countries, the UN General Assembly held a Special Session from 23 May to 1 July 1978, entirely devoted to disarmament. It was attended by a large number of heads of state or government as well as foreign ministers. In addition to official representatives taking part in the debate and negotiations, 25 non-governmental organizations and 6 research institutes, including SIPRI, were given an opportunity to present their views on items on the session's agenda. (For an excerpt from the SIPRI statement, see appendix 11B.) The session produced a Final Document which contains a Declaration, a Programme of Action and a section on the international machinery dealing with disarmament. (For the text of the Final Document, see appendix 11A.)

The General Assembly resolution [1] adopting the Final Document was approved without a vote being taken, that is, in effect by consensus.[1] In UN practice, 'consensus' merely means that no delegation is strongly enough opposed to a text to exercise its absolute right to demand a vote on it so that it might formally record its negative stand or abstention. Therefore, consensus may be understood as denoting agreement on the main lines of a text, implying that a compromise has been reached on basic issues, while individual delegations may have different interpretations of certain, usually less essential, provisions. At the Special Session, however, after the adoption of the Final Document, in which the member states of the United Nations declared that they would respect the objectives and principles contained therein and would make every effort "faithfully" to carry out the programme of action (paragraph 42 of the Final Document), many states made explanatory statements in which they reserved their position on, or took exception to, a number of points having fundamental importance (as did China and France) or placed general reservations on the Document (as did Brazil) [5a]. One country (Albania) even rejected the Document

[1] The Preparatory Committee for the Special Session recommended that the rules of procedure for the General Assembly should also apply to the Special Session, on the understanding that every effort should be made to ensure that, as far as possible, decisions on matters of substance would be adopted by consensus [2]. This recommendation, which had been endorsed by the General Assembly at its thirty-second regular session [3], was referred to at the opening meeting of the Special Session [4].

in its entirety [5b]. Therefore, the unopposed adoption of the Special Session's resolution cannot be considered as a fully adequate reflection of the views of the UN members on the problems of disarmament.

A good part of the Final Document simply reiterates the general principles and goals as defined in UN resolutions adopted during the past 30 years, and particularly since 1969, when the United Nations declared the 1970s the Disarmament Decade [6]. But, in the search for a consensus at the Special Session, some previous UN General Assembly recommendations, representing the views of the majority, were watered down to the least common denominator in order to accommodate the views of the minority. Nevertheless, the Final Document contains a few new elements of both substantive and procedural nature, which may indicate a shift in the standpoint of certain states or groups of states. These will be especially elaborated in this chapter. Attention will also be devoted to specific proposals made, but not discussed in detail, during the Session, since many of them may become the subject of future disarmament negotiations.

II. The Declaration

Assessment of the situation, objectives and priorities

The participants in the Special Session were unanimous in stating that the arms race aggravates international tensions, sharpens conflicts in various regions of the world, hinders détente, exacerbates the differences between opposing military alliances, jeopardizes the security of all states, and increases the threat of nuclear war (paragraph 11 of the Final Document). Therefore, in spite of disagreement on the causes of the arms race, they agreed that disarmament is an imperative and the most urgent task facing the international community.

In assessing the arms control agreements hitherto reached, the participants in the Special Session found no "real" progress in the field of reduction of armaments (paragraph 17). This was a diplomatic understatement, because the agreements in question have not reduced the military potential of states and have therefore failed in a most essential respect.

Further, the Final Document declares general and complete disarmament under effective international control to be the ultimate objective of the efforts of states in the disarmament process (paragraph 19). It will be recalled, however, that negotiations for a single treaty on general and complete disarmament, initiated in the early 1960s, were interrupted some 15 years ago, and that the appeals repeatedly addressed to the

USA and the USSR to update their proposals [7, 8] for such disarmament have remained without response. The reluctance of the two great powers to submit revised versions of their own draft treaties for a renewed discussion may have reflected their scepticism about the possibility of ever reaching general and complete disarmament. There now seems to be a common understanding that progress towards this desirable though distant goal would be facilitated by the conclusion of a series of agreements on partial but effective measures of disarmament (paragraph 19).

The list of priorities for disarmament negotiations includes the following items (paragraphs 20–24):

(*a*) nuclear disarmament and the prevention of nuclear war;

(*b*) prohibition of other weapons of mass destruction, including, in the first place, elimination of chemical weapons;

(*c*) balanced reduction of armed forces and of conventional armaments, as well as limitation of international transfer of conventional weapons;

(*d*) prohibition or restriction of the use of specific conventional weapons, including those which may be excessively injurious, cause unnecessary suffering or have indiscriminate effects; and

(*e*) collateral measures in nuclear and conventional fields, specifically designed to build international confidence.

The novelty here is the parallel treatment of nuclear and conventional disarmament, including restrictions on transfer of conventional arms, since non-nuclear measures of disarmament had hitherto been contemplated mainly within the framework of general and complete disarmament. This change of approach is important, not only because conventional armaments account for the bulk of world military expenditures, but also because the very possession of nuclear weapons has been justified by a perceived need to deter aggression started with conventional weapons. And a conventional armed conflict might well escalate into a nuclear war. However, the call for conventional disarmament, as formulated in the Final Document, is heavily qualified as follows: the principle of undiminished security of the parties must be observed; particular emphasis ought to be placed on armed forces and conventional weapons of nuclear weapon states and other militarily significant countries; and, in limiting the international transfer of conventional weapons, account must be taken of the right to self-determination and independence of peoples under colonial or foreign domination and the obligations of states to respect that right, as well as the need of recipient states to protect their security (paragraph 22).

Viet Nam felt that a distinction should be drawn between arms possessed by the "forces of aggression" and those held by "patriots struggling to free themselves from the colonial and racist yoke" [5c]. But the United Kingdom made it clear that its acceptance of the Final Document's formulation regarding conventional disarmament did not imply acceptance of the desirability of using force to resolve conflicts arising from the search for self-determination [5d]. Moreover, the very notion of security, the attainment of which is considered to be an "inseparable element of peace" (paragraph 1), and the preservation of which conditions possible reduction of armaments, has not been defined at all in the Final Document. And yet it is common knowledge that many valuable disarmament initiatives have been blocked, and meaningful negotiations made impossible, on account of 'national security'.[2]

Governing principles for negotiations

An important principle proclaimed by the Special Session is that all states have the duty to contribute to efforts in the field of disarmament, and the right to participate in disarmament negotiations. However, the Final Document emphasizes that the nuclear weapon states have the primary responsibility for nuclear disarmament and, together with other militarily significant states, for halting and reversing the arms race (paragraphs 27 and 28). This formulation, implying that all nuclear weapon states are equally responsible for bringing about disarmament, met with strong objections on the part of China and France. China insisted that disarmament must start with the two "superpowers", that is, the USA and the USSR, and that only when major progress had been made in the destruction of their nuclear arsenals and in the reduction of their conventional armaments, should the other nuclear weapon states join in destroying "all" nuclear weapons [9]. Also France stated the view that halting the arms race would depend, first and foremost, on the efforts of the USA and the USSR. It added that, if after successive reductions the "nature" of the disparity between the nuclear strategic forces of the USA and the USSR and those of France had been altered, France could act "accordingly" [10]. Indeed, as has been pointed out by many nations and on several occasions,[3] the size of the US and Soviet nuclear arsenals is such that, even if these two powers decided to halve their nuclear arsenals, the number of nuclear weapons and delivery vehicles which each one of them would maintain would still be much superior to that which might be at the disposal of all the other nuclear weapon states taken together.

[2] Cyprus proposed that the next Special Session be named the "special session on disarmament and security" [5e].

[3] One such occasion was, for example, the 1975 Review Conference of the Non-Proliferation Treaty.

Another principle requires that disarmament measures should take place in an equitable and balanced manner so as to ensure the right of each state to security, and that no individual state or group of states should obtain advantages over others at any stage (paragraph 29). It may be noted that a similar requirement, included in the 1961 US – Soviet Joint Statement of agreed principles for disarmament negotiations [11], had no bearing on negotiations themselves, because it was understood differently by different countries. According to one interpretation, primary importance was to be attached to the 'no advantage' clause, which may imply that cuts in armaments must be equal, either in absolute or percentage terms. Another interpretation was that the size of the cuts carried out by individual states may vary, as long as no one state's security was placed in jeopardy. This controversy is likely to continue, as exemplified *inter alia* by the recent dispute over symmetrical versus asymmetrical reductions of forces in Central Europe [12].

Yet another principle calls for an acceptable balance of mutual responsibilities and obligations for nuclear and non-nuclear weapon states (paragraph 30 of the Final Document). This is a plea for non-discrimination, which has its origins in the experience with the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Under this treaty, the non-nuclear weapon states have assumed the main burden of obligations by renouncing the nuclear weapon option, while the nuclear weapon states, in undertaking not to disseminate the weapons, have sacrificed little, if anything.

It is further stipulated that disarmament and arms limitation agreements should provide for measures of verification satisfactory to all parties concerned; that the form and modalities of the verification to be provided for in any specific agreement depend upon and should be determined by the purposes, scope and nature of the agreement; and that agreements should provide for the participation of parties in the verification process (paragraph 31). The formula used here is flexible enough to put to rest the controversy, which had been going on between the USA [13] and the USSR [14] since the early 1960s, over whether control should apply only to actual reductions or also to the retained levels of armaments. As a matter of fact, the existing technical means of collecting intelligence information, mainly reconnaissance satellites, have made it possible to monitor certain major developments in world armaments, irrespective of whether international treaties limiting these armaments have been concluded. The problem, however, is that this sophisticated equipment is now in the possession of two powers only, and that nations lacking it may not be in a position to ascertain whether the commitments of other states are being observed. To meet the requirement of the Final Document that all parties to agreements should participate in the verification process, there would have to be more sharing of the technical know-how in the field of control.

Claiming that there exists a close relationship between disarmament and development, the Final Document states that resources released as a result of disarmament measures should be devoted to the economic and social development of all nations, and to bridging the economic gap between developed and developing nations (paragraph 35).

Other principles deal with the need to avoid a nuclear war (paragraph 32), to establish nuclear weapon-free zones (paragraph 33), to prevent proliferation of nuclear weapons (paragraph 36), and to cease the qualitative improvement of armaments, in addition to quantitative disarmament, so that scientific and technological achievements may be used solely for peaceful purposes (paragraph 39).

Finally, it is postulated that negotiations on partial measures of disarmament should be conducted concurrently with negotiations on more comprehensive measures (paragraph 38); that efforts should be made to ensure universality of disarmament agreements (paragraph 40); and that nations should refrain from actions which might adversely affect disarmament efforts (paragraph 41). Unilateral measures of arms limitation or reduction are also encouraged.

III. Programme of action

This part of the Final Document enumerates measures to be implemented over the next few years, as well as studies preparing the way for future negotiations.

Nuclear disarmament

To achieve nuclear disarmament, the Final Document calls for negotiations on (*a*) the cessation of the qualitative improvement and development of nuclear weapon systems; (*b*) the cessation of the production of all types of nuclear weapon and their means of delivery, and of the production of fissionable material for weapons purposes; and (*c*) a comprehensive, phased programme with agreed time-frames, whenever feasible, for progressive and balanced reduction of stockpiles of nuclear weapons and their means of delivery (paragraph 50).

A proposal to start negotiations at a specific date for "ending the production of all types of nuclear weapons and gradually reducing their stockpiles until they have been completely destroyed" was put forward at the Special Session by the USSR [15]. The Soviet Union said, however, that these measures should be implemented parallel to, and be inseparable from, the consolidation of political and international legal guarantees for the security of states, and that the conclusion of a world treaty on the non-use of force in international relations would be an important step in this direction [16]. It is noteworthy that the participants in the negotiations proposed by the USSR would include not only all the nuclear weapon powers, but also a "certain number" of non-nuclear weapon states.

Canada stated that it had withdrawn from any nuclear role for its armed forces in Europe, and that it was in the process of replacing with conventional armed aircraft the nuclear-capable planes assigned to its forces in North America [17]. It suggested that the two major nuclear powers should agree to stop the flight-testing of new strategic delivery vehicles, so as to curb the qualitative dimension of the strategic arms race [18].

Cessation of fissionable material production for weapons purposes is usually considered to be a first step towards the cessation of nuclear weapon production. However, the amounts of such material already accumulated by the nuclear weapon states make it possible for them to continue the manufacture of arms for an indefinite period. Unilateral reductions in the production of highly enriched uranium, as well as plutonium, simultaneously announced by the USA [19] and the USSR [20] on 20 April 1964, have had no effect at all on the nuclear arms race. The only immediate positive result of a permanent cut-off of the production of fissionable material for weapons purposes under an international treaty could be the establishment of international safeguards on all the relevant activities of nuclear weapon states, making up for the discriminatory treatment of non-nuclear weapon states subject to full-scope control under the NPT.

Cessation of nuclear weapon tests

The Final Document appeals to the "negotiating parties", that is, the UK, the USA and the USSR, to conclude the negotiations on a "treaty prohibiting nuclear-weapon tests, and a protocol covering nuclear explosions for peaceful purposes, which would be an integral part of the treaty". The countries concerned are also asked to submit the result of these negotiations for full consideration by the multilateral negotiating body with a view to the submission of a draft treaty to the UN General Assembly (paragraph 51). The cessation of nuclear weapon testing was viewed by most participants at the Special Session as a possible significant contribution to the aim of ending the qualitative improvement and the development of new types of nuclear weapon and of preventing the proliferation of such weapons. On behalf of the non-nuclear weapon states, an opinion was recorded in the Final Document that, pending the conclusion of the test ban treaty, the world community would be encouraged if all the nuclear weapon powers refrained from testing nuclear weapons. This addition was initiated by India, which reiterated its pledge not to manufacture or acquire nuclear weapons "even if the rest of the world did so", and not to conduct nuclear explosions "even for peaceful purposes" [21]. In a draft resolution, co-sponsored by Cyprus and Ethiopia, India called for a moratorium on nuclear testing [22], but met with objections on the part of the USA on the grounds that an immediate cessation of nuclear testing could "seriously" complicate the process of elaborating adequate measures of verification in which the USA was engaged [5f]. In supporting the idea of a moratorium, Australia and New Zealand [23] as well as Japan [24] suggested a few amendments to the Indian proposal, but the draft resolution was not pressed to a vote, partly because there was heavy political pressure to have no resolution other than the one incorporating the Final Document.

On the other hand, China opposed a general ban on nuclear weapon tests (as well as the cessation of nuclear weapon production or the prohibition of nuclear weapon proliferation) as "totally unacceptable". It argued that such measures would serve only to maintain and consolidate the nuclear supremacy of the USA and the USSR [5g]. France also "completely" dissociated itself from the consensus on the relevant paragraph of the Final Document. It stated the view that a halt to testing would not produce a qualitative freeze in nuclear weapons, because the two most heavily armed powers, due to numerous tests already carried out by them, had accumulated sufficient data for further improvement of weapons without new tests, and that the cessation of this activity would therefore make no decisive contribution to preventing the production of new types of weapon or to non-proliferation [5h].

Strategic arms limitation

The Final Document calls upon the USA and the USSR to conclude at the earliest possible date an agreement pursued in the second round of the Strategic Arms Limitation Talks (SALT II), and to transmit the text to the General Assembly. This agreement should be followed promptly by negotiations leading to agreed significant reductions of, and qualitative limitations on, strategic arms (paragraph 52).

In their statements made at the Special Session, the powers in question confirmed that the SALT II agreement would reduce the number of strategic delivery vehicles now in existence and put a ceiling on the remainder; establish sublimits for those systems which are most destabilizing; and impose restraints on the improvement of existing weapons and the development of new and more sophisticated systems [25a]. As far as SALT III is concerned, they expressed readiness to negotiate a substantial reduction in the levels of strategic arms as well as further limitations on modernization of delivery vehicles [26a].

Prevention of a nuclear war

During the Special Session various proposals were made for the prevention of nuclear war pending nuclear disarmament. The most far-reaching proposal was that made by India (and supported by Ethiopia), which would declare the use of nuclear weapons to be a violation of the UN Charter and a crime against humanity [27]. A declaration to this effect was adopted by the UN General Assembly as early as 1961, by a vote of 55 to 26, with 20 states abstaining [28], but because of the strong opposition on the part of three of the four nuclear weapon powers then in existence, the provision for convening a conference to sign a convention prohibiting the use of nuclear weapons was not followed up.

In recent years, a series of bilateral agreements have been entered into between the USSR on the one hand, and the USA, the UK and France on the other, to reduce the risk of accidental outbreak of nuclear war. But a blanket prohibition of use of nuclear weapons has never been seriously contemplated by these states, as this would be incompatible with their military doctrines: neither of them is prepared to forgo recourse to nuclear weapons in self-defence, even against an aggressor using only conventional weapons. China is the only country to have unequivocally committed itself not to be the first to use nuclear weapons at any time and under any circumstances [29]. The Final Document calls for an international agreement to secure the avoidance of the use of nuclear weapons, but requires, at the same time, that efforts should be made to bring about conditions in relations among states in which a "code of peaceful conduct" of nations in international affairs could be agreed and which would preclude the use or threat of use of nuclear weapons (paragraph 58). In the foreseeable future, this provision of the Document has little chance of materializing.

It will be recalled that, under a 1968 UN Security Council resolution, the states forgoing the acquisition of nuclear weapons according to the Non-Proliferation Treaty received an assurance of immediate assistance in the event that they became "a victim of an act or an object of a threat of aggression in which nuclear weapons are used" [30]. The value of these so-called positive security guarantees is questionable on several accounts, their greatest deficiency being that action is envisaged only when a threat of nuclear attack has been made or an attack has already occurred. Therefore, the non-nuclear weapon states, especially the non-aligned, which have given up the nuclear weapon option and are not covered by the protective nuclear 'umbrella' of the great powers, have been asking for so-called negative security guarantees to prevent the use or threat of use of nuclear weapons against them. Now, after many years of refusal, the Soviet Union, the United States and the United Kingdom seem to be yielding to these demands.

On 26 May 1978 the Soviet Foreign Minister, addressing the Special Session, declared that the USSR would never use nuclear weapons against those states which "renounce the production and acquisition of such weapons and do not have them on their territories" [26]. Related to this declaration was the Soviet proposal for an obligation to be assumed by nuclear weapon powers not to station nuclear weapons in the form of deployed weapon systems, or in the form of stockpiles of warheads, bombs, shells or mines, on the territories of those states where there are no nuclear weapons today [15].

On 12 June 1978, the US President announced in Washington that the USA would not use nuclear weapons against any non-nuclear weapon state which is party to the NPT or "any comparable internationally binding agreement not to acquire nuclear explosive devices" [31]. A similar statement was subsequently issued by the UK [32]. France reiterated its position that it was prepared to give assurances of the non-use of nuclear weapons, in accordance with arrangements to be negotiated, only to those states which have "constituted among themselves non-nuclear zones" [5h].

None of these declarations seems to go far enough in providing adequate guarantees. The Soviet Union required that "appropriate" bilateral security agreements be concluded between the nuclear and non-nuclear weapon countries—something that is obviously unacceptable to the neutral and non-aligned states, not to speak of the members of the military alliances. The United States, on the other hand (similarly to the United Kingdom), has explicitly excluded from its non-use commitment non-nuclear weapon states allied to a nuclear weapon power or "associated" with such a power in carrying out an attack on the USA or its allies. And France, as mentioned above, has restricted its non-use guarantees to nuclear weapon-free zones.

In view of these disparities and the possibility of divergent interpretations of unilateral undertakings, the Special Session simply noted the declarations made by the nuclear weapon states and urged them to conclude effective arrangements, as appropriate, to assure non-nuclear weapon states against the use or threat of use of nuclear weapons (paragraph 59 of the Final Document).[4] However, Belgium remarked that the non-use of force or the threat of force is an "absolute principle" which is not limited to the use or threat of use of nuclear weapons, as the language of the relevant paragraph of the Final Document might suggest [5j].

The question of security assurances is essentially a multilateral proposition which should promote the climate of confidence. Starting from this premise, Pakistan suggested that unilateral declarations on the non-use of nuclear weapons should be incorporated in a Security Council resolution and given binding force under a legal instrument. It also proposed a formula under which security assurances would be provided, "for the time being", only to those non-nuclear weapon states that are "not parties to the nuclear security arrangements of some nuclear weapon powers" [29].

Nuclear weapon-free zones and zones of peace

In addition to world-wide security arrangements for non-nuclear weapon states, the nuclear weapon powers are called upon to undertake to respect the status of nuclear weapon-free zones, and to refrain from the use or threat of use of nuclear weapons against the states of the zones. The modalities of such undertakings are to be negotiated with the competent authority of each zone (paragraphs 60, 61 and 62 of the Final Document). With regard to the latter requirement, the USA has placed on record its understanding of the term "modalities" as referring both to the substantive provisions and to the procedures to be included in the undertakings in question [5k]. This reservation should be seen in the light of the UN resolution of 11 December 1975 [33] (opposed by the USA), which tried to impose specific obligations on nuclear weapon powers with respect to any nuclear weapon-free zone recognized as such by the UN General Assembly.

It is noteworthy that on the eve of the Special Session, the USSR signed Protocol II of the Treaty of Tlatelolco prohibiting nuclear weapons in Latin America. It will thus become the fifth nuclear weapon power (after the UK, the USA, France and China) to be legally bound to respect the denuclearized status of this zone. France announced that it was considering signing Protocol I of the Treaty of Tlatelolco, so as to apply the status of military denuclearization to its territories lying within the geographical limits established by the treaty, while the USA promised a speedy ratification of the same protocol. Since also

[4] Alluding to the nuclear activities of Israel and South Africa, Jordan called upon the nuclear weapon powers to give non-nuclear weapon states in the Middle East and Africa which are parties to the Non-Proliferation Treaty "assured guarantees against nuclear attacks by a third party" [5i].

Argentina, one of the few non-parties in Latin America, started the procedures necessary for the ratification of the Treaty of Tlatelolco, an advance has been made towards the full application of this treaty.

India stated that there cannot be a limited approach to the question of freedom from nuclear threats and dangers and that, therefore, "the whole world should be declared a nuclear-free zone" [21a]. Nevertheless, the Final Document affirmed that the establishment of nuclear weapon-free zones is an important disarmament measure (paragraph 60), and recalled UN General Assembly resolutions on the desirability of setting up such zones in Africa, the Middle East and South Asia (paragraph 63).

The Final Document also notes the existing proposals for zones of peace in South-East Asia and the Indian Ocean (paragraph 64), but it has failed to specify in which respects the concept of a 'zone of peace' differs from, or overlaps with, the concept of a 'nuclear weapon-free zone'.[5] The USA said that, in its view, zones of peace have to be determined not only by states in the zone, but by all states concerned, wherever situated [34], and that the establishment of such zones must be consistent with the inherent right of individual and collective self-defence guaranteed in the UN Charter, or other rights recognized under international law, "including the right of innocent passage and historical high-seas freedoms" [5k].

The countries working towards the establishment of a zone of peace in the region of South-East Asia are Indonesia, Malaysia, the Philippines, Singapore and Thailand, grouped in the Association of South-East Asian Nations (ASEAN). Also Viet Nam has expressed interest in a South-East Asian zone of peace, but the principles it proposed for defining the zone did not include measures of disarmament [35].

Regarding the Indian Ocean, the Soviet Union referred to its negotiations with the USA for an agreement "freezing" the military activities in the area, and suggested that such an agreement should be followed by talks on a drastic reduction of military activities there, including the dismantling of foreign bases [15]. India submitted that the USA and the USSR should work for the "complete" demilitarization of the Indian Ocean [5m], because, in its view, this was the meaning of the declaration on the subject adopted by the United Nations in 1971 [36], while Pakistan thought that also littoral and hinterland states of the Indian Ocean should exercise restraint and take measures to create conditions of security, including the denuclearization of the entire region [5j]. The

[5] For example, the Soviet Union which, since the late 1950s, has been advocating the establishment of a zone of peace in the Baltic, has made it clear that it does not envisage denuclearization of the whole region.

representative of Nepal proposed that his country be declared a zone of peace [37].

Suggestions were also made to include the Mediterranean [38a] and the Balkans [39] in the list of prospective zones of peace. Malta would like the Mediterranean to be declared a zone "free of nuclear weapons" [29], while Romania would like to see the Balkans converted into an area "without nuclear weapons, foreign military bases or foreign troops" [40]. Neither proposal attracted general attention.

Non-proliferation of nuclear weapons

The prevention of nuclear weapon proliferation is considered in the Final Document as an integral part of the effort to halt and reverse the arms race (paragraph 65 of the Final Document). Nevertheless, little attention is devoted to the Non-Proliferation Treaty, which has been accepted by a substantial majority of the international community as the basic legal instrument serving the above purpose.

Note is taken in the Final Document of the increased adherence to the NPT in recent years (paragraph 67), but a call for universal adherence has been omitted. In contrast, much is said about the right of states to develop civilian nuclear programmes, and to have access to all relevant technology, equipment and materials on a non-discriminatory basis (paragraphs 68 and 69). Also, the International Nuclear Fuel Cycle Evaluation (INFCE) is mentioned (paragraph 71).[6]

The NPT itself provides for international cooperation in the application of nuclear energy for peaceful purposes, but this provision is clearly subordinated to the obligation not to manufacture and not to assist in the manufacture of nuclear weapons or other nuclear explosive devices. Therefore, excessive emphasis on peaceful uses of nuclear energy, as it appears in the Final Document, has distorted the arms control aspect of non-proliferation. The distortion is a result of concessions to a group of countries, mainly Brazil and India, which have refused to be bound by the NPT and which would rather make no reference to it at all. This seems to be the highest price paid by the majority of states to avoid voting on the Final Document.

[6] The final communiqué of 21 October 1977 of the Organizing Conference of INFCE states that effective measures should be taken at the national level and through international agreements to minimize the danger of the proliferation of nuclear weapons without jeopardizing energy supplies or the development of nuclear energy for peaceful purposes. The participants in the conference agreed that INFCE was to be a technical and analytical study rather than a negotiation. The results are to be transmitted to governments for their consideration in developing their nuclear energy policies and in international discussions concerning nuclear energy cooperation and related controls and safeguards [41].

Other weapons of mass destruction

The Final Document appeals to all states to adhere to the 1925 Geneva Protocol prohibiting the use of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare, as well as the 1972 Biological Weapons Convention (paragraphs 72 and 73), and to conclude conventions prohibiting the development, production and stockpiling of all chemical as well as radiological[7] weapons (paragraphs 75 and 76). In addition, it mentions the desirability of widening the scope of the 1977 Environmental Modification Convention so as to eliminate the dangers from any hostile use of environmental modification techniques; of considering measures, supplementary to those included in the 1971 Sea-Bed Treaty, for preventing an arms race in the sea-bed environment; and of considering measures to prevent an arms race in outer space, in accordance with the spirit of the 1967 Outer Space Treaty (paragraphs 78, 79 and 80).

Among the new treaties mentioned above, the chemical weapons convention is generally considered to be of utmost importance. But in their bilateral talks on a joint initiative concerning the prohibition of these weapons, to be submitted to the Disarmament Committee, the USA and the USSR have so far not been able to resolve a number of issues relating mainly to verification [42]. At the same time, they are unwilling to have the existing controversies discussed in a multilateral forum.

The Final Document recommends that effective measures should be taken to avoid the danger and prevent the emergence of new types of weapons of mass destruction based on new scientific principles and achievements (paragraph 77). In this context, the Soviet Union referred to the draft international convention on the prohibition of the production, stockpiling, deployment and use of nuclear neutron (reduced blast/enhanced radiation) weapons, submitted by a group of socialist states at the Conference of the Committee on Disarmament (CCD) in March 1978 [43]. It asked that high priority should be accorded to this measure, and pledged not to begin the production of neutron weapons as long as the USA does not produce them [15].

The principal arguments put forward by the USSR in favour of a ban on neutron weapons are that these are indiscriminate and particularly cruel weapons of mass destruction; that they could be used both offensively and defensively, as well as strategically and tactically; that their deployment would escalate the arms race and lower the threshold

[7] 'Radiological weapons' have been defined by the Soviet Union as weapons which affect living organisms by radiation resulting from the non-explosive disintegration of radioactive material [15].

of nuclear conflict; and that their introduction in Europe would destabilize the current political and military situation. On the other hand, the USA argues that neutron weapons are tactical weapons considered as defence against a possible massive tank attack in Central Europe; that they would greatly reduce the extent of damage that might be caused by blast, heat and fall-out outside the target area and would therefore strengthen deterrence; and that their deployment would not make it easier to cross the nuclear threshold in case of war [42]. In view of these differences, neutron weapons were not mentioned in the Final Document.

The USA suggested addressing the whole question of tactical, or theatre, nuclear weapons in Europe, including both neutron weapons and the Soviet mobile intermediate-range ballistic missiles, the so-called SS-20, targeted at Europe. The problem, however, is that there exists at present no forum where control over non-strategic nuclear weapons is discussed. The weapons in question fall outside the terms of reference of SALT, and they are only marginally dealt with in the Vienna Mutual Force Reduction (MFR) talks concerning Central Europe.

Conventional disarmament

While stating that countries with the largest military arsenals have a special responsibility for pursuing the process of conventional armaments reductions, the Final Document stresses the importance of agreements reached on a regional basis. A view was expressed by France that no approach to disarmament would be complete unless measures at the world level were supplemented by "action to reduce armaments taken on the basis of regional situations" [10], and Belgium was pressing its proposal for a systematic study of regional disarmament questions [5n] in accordance with the resolution adopted at the thirty-second UN General Assembly [44].[8] Two regions are specifically mentioned in the Final Document—Europe and Latin America.

As regards Europe, a lower level of military potential is postulated on the basis of approximate "equality and parity" (paragraph 82). This formulation is due to the progress made at the MFR talks in Vienna, where the USSR has accepted the Western concept of a common ceiling of forces for each side in the Central European theatre [46]. The forces involved are those of the Soviet Union, Czechoslovakia, the German Democratic Republic and Poland, on the Warsaw Treaty Organization side, and the United States, Belgium, Canada, the Federal Republic of

[8] Communications from governments, containing views on regional aspects of disarmament, have been reproduced in the Secretary-General's report published on the eve of the Special Session [45].

Germany, Luxembourg, the Netherlands and the United Kingdom, on the NATO side.

France, which is not taking part in the Vienna talks, suggested that all the 35 participants in the Conference on Security and Co-operation in Europe should meet to discuss disarmament in Europe. The conference would in the first stage aim at building up trust among the countries concerned by instituting measures for the provision of appropriate information and notification and, in the second stage, at achieving a genuine reduction of armaments within the "European geo-strategic complex that extends from the Atlantic to the Urals" [10a].

As regards Latin America, reference is made in the Final Document to the Declaration of Ayacucho of 9 December 1974 (paragraph 84). In this declaration, Argentina, Bolivia, Chile, Colombia, Ecuador, Panama, Peru and Venezuela undertook to create conditions permitting an effective limitation of armaments and putting an end to their acquisition for "offensive purposes", so that all possible resources could be devoted to economic and social development [47]. Several meetings held since the signing of the Declaration of Ayacucho have not succeeded in translating its provisions into an internationally binding instrument. Nevertheless, the signatories of the Declaration, meeting in Washington at the time of the Special Session, reaffirmed its principles and stated their willingness to explore, together with other Latin American countries, possibilities for reaching an agreement on limiting conventional weapons in Latin America [48].

A proposal for "total demilitarization and disarmament" of the Republic of Cyprus and the formation of a Cypriot police force under the permanent control of a UN police force was put forward at the Special Session by the President of Cyprus [49]. The proposal was vigorously opposed by Turkey [23], and was not included in the Programme of Action. The dismantling of military bases in foreign territories and the withdrawal of foreign troops from such territories, as suggested by the non-aligned states [38b], was also not included in the list of recommended measures.

As regards the prohibition or restriction of use of certain conventional weapons which may cause unnecessary suffering or have indiscriminate effects, the Final Document calls upon all states to contribute towards this task at a special UN conference to be held in 1979 (paragraphs 86 and 87). A successful outcome of this conference would be of special significance, since the laws of war which relate directly to the conduct of hostilities by banning or restricting the use of a specific weapon or type of weapon, as distinct from rules designed to accord protection to certain persons, places or objects in armed conflicts, have developed very little since the 1907 Hague

Conventions. The weapons most often mentioned in the context of the forthcoming negotiations are incendiaries, including napalm, small-calibre high-velocity projectiles, certain blast and fragmentation weapons, including weapons the primary effect of which is to injure by fragments not detectable by X-ray, as well as mines and booby-traps.

Yugoslavia advocated the banning of the development, production and deployment of all new types of conventional weapons and new systems of such weapons [25].

Arms transfers

Many Third World countries view with suspicion proposals for limiting the international flow of arms, and tend to regard such proposals as attempts to impose unilateral disarmament on them. On the other hand, the traffic in arms is encouraged by the suppliers of weapons, although the recently initiated US–Soviet talks to work out a joint approach to arms shipments abroad may indicate a change in the attitudes at least of these two powers.[9]

The Final Document recommends that major arms supplier and recipient countries should conduct consultations on the limitation of all types of international transfer of conventional weapons (paragraph 85). This is the first time that such a recommendation has been made by the United Nations, but the mechanisms or the procedures necessary for the envisaged consultations have not been specified. Colombia saw the need for an inquiry to assess the size of the trade in conventional weapons, its trends and projections [51]. Turkey made a reference to past proposals for international registration of weapon transfers, which it supported, and asked that, in addition, measures be taken to prevent illegal sales and contraband of arms [52]. However, the suggestions made by Japan [53] and the UK [54] for a UN study on ways to limit and reduce the build-up of conventional weapons, including the international transfer of such weapons, were not accepted.

The question of arms embargo was also raised during the Special Session.

By a letter from its chairman to the President of the General Assembly, the Special Committee against Apartheid drew the attention of the Assembly to the need for further action to ensure the full implementation of the arms embargo against South Africa, and to prevent South Africa from acquiring a nuclear weapon capability [55].

[9] Following preliminary discussions, the USA and the USSR have agreed to hold negotiations aimed at creating 'common guidelines' on transfers of conventional weapons [50].

Iraq proposed,[10] in a draft resolution sponsored by 33 delegations, that states should refrain from any supply of arms, ammunition, military equipment or vehicles, or any spare parts thereof, to Israel; that they should ensure that such supplies do not reach Israel through other parties; and that they should terminate all transfer of nuclear equipment or fissionable material or technology to Israel. The UN Security Council would be requested to establish a machinery for supervising the implementation of the above measures [58]. Irrespective of individual states' positions on the substance of the Iraqi proposal, the overwhelming feeling was that a separate resolution on a highly controversial regional issue would diffuse the focus of the session and undermine the consensus on the Final Document.[11] But it was only at the very end of the Session that the sponsors, yielding to requests from a number of countries, decided not to press the draft resolution to a vote [60].

Reduction of military expenditures

Another approach to disarmament—through reductions of military expenditures—was extensively discussed at the Special Session. The Soviet Union modified its 1973 proposal for a percentage cut in military budgets of the permanent members of the UN Security Council [61], by suggesting that all states with a large economic and military potential should agree on reductions in absolute terms instead of percentages. Such an agreement would cover, for instance, a period of three years, and specific amounts would be allocated for increased aid to developing countries [15]. In a related move, France proposed the establishment of an International Disarmament Fund for development,[12] the contributors to which would be those states which are most heavily armed and most developed, while its beneficiaries would be the poorest and least armed states [63]. The initial endowment was to be around $1 thousand million [64]. Mexico suggested that, pending the establishment of such a fund, an *ad hoc* account be opened in the UN Development Programme

[10] The proposal was made in accordance with a resolution adopted at the extraordinary meeting of ministers of foreign affairs of non-aligned countries and observers participating in the Special Session [56], and was based on a study of Israel's armaments, prepared by the Iraqi Ministry of Foreign Affairs [57].

[11] This viewpoint was elaborated in *Disarmament Times*, a newspaper published during the Special Session under the auspices of the Non-Governmental Organizations Disarmament Committee [59].

[12] As early as July 1955, at the Geneva Conference of Heads of Government, the French Prime Minister proposed that a reduction of military expenditures be agreed among states, and that the financial resources thus made available be allocated to "international expenditure on equipment and mutual aid", including assistance to underdeveloped territories. The French memorandum envisaged the creation of a special international fund as well as an international secretariat to supervise the use of the resources [62].

to use for development the resources released as a result of disarmament measures [65a]. Italy expressed the view that a percentage of the sums devoted to armaments should be set aside for the international financing of the struggle against pollution of the human environment, deforestation or overpopulation [54].

Senegal proposed that a 5 per cent tax on military budgets be imposed on all states, paid to the United Nations, and used solely for assistance to the developing countries [66], while China insisted that the USA and the USSR, having the largest military expenditures, should take the lead in reducing these expenditures [67]. Canada, in turn, suggested that the major nuclear powers should limit and then progressively reduce, on an agreed and verifiable basis, spending on new strategic nuclear weapon systems, including their research and development [18].

Ireland discussed the possibility of setting a ceiling, or ceilings, on national defence expenditures, expressed as a proportion of gross national or domestic product [68]. This would resemble the target adopted at the international level for the percentage of gross national product which the developed countries have been called upon to devote to development aid. And to encourage disarmament by creating direct incentives, Costa Rica suggested channelling a substantial portion of the resources released by the reduction of military budgets to countries which reduce their military expenditures to less than 1.5 per cent of their public budget and less than 0.5 per cent of their national product, concurrently, regardless of their level of development [69].

In messages addressed to the Special Session, the UN Children's Fund (UNICEF) asked that a portion of the savings obtained as a result of a reduction of expenditures on armaments be directed through national and multinational programmes towards meeting the minimum requirements of children—adequate nutrition, safe water, primary health care and suitable education [70];[13] the UN Food and Agriculture Organization (FAO) pointed out the inadequacy of resources devoted to agriculture, especially in the poorer countries, and the growing number of undernourished in the world [72]; and the World Food Council asked for allocating a share of resources released through cuts in military expenditures to improve the food situation in the developing countries [73].

The Final Document considers gradual reduction of military budgets as a measure that would contribute to the curbing of the arms race and increase the possibilities of reallocation of resources used for military purposes to economic and social development, particularly for the

[13] Iran responded to this appeal by announcing its intention to divert from its defence budget approximately $7 million in support of projects related to the International Year of the Child [71].

benefit of the developing countries (paragraph 89). However, as long as no standardized system of international measurement, reporting and comparison of military expenditures has been adopted by all the militarily significant states, as suggested by the United Nations [74], there is no basis for carrying out this measure,[14] and no treaty for the reduction of military expenditures is therefore likely to be concluded.

In any event, unless it is very significant (and this has not been proposed), a reduction of military expenditures is not, in itself, the most effective method of bringing about disarmament—rather, substantial and verifiable agreed cuts in armaments would inevitably have to be followed by cuts in expenditures. Neither is a reduction of military expenditures the only or even primary way to increase assistance to the developing countries. But as a collateral measure it could promote disarmament by building up confidence among nations.

Verification of disarmament agreements

To facilitate effective implementation of disarmament agreements, the Programme of Action calls for the development of methods and procedures of verification that are non-discriminatory and do not unduly interfere with the internal affairs of states (paragraphs 91 and 92 of the Final Document). Several proposals dealing with the problem of verification were submitted during the Special Session.

France suggested the establishment of an agency having the status of a specialized agency of the United Nations, which would collect, process and disseminate information secured by means of Earth observation satellites.[15] The functions of the agency would include participation in monitoring the implementation of international disarmament and security agreements, whether already in force or to be concluded, as well as participation in the investigation of a specific situation either at the request of one state, with the consent of the state to be inspected, or at the request of the UN Security Council. The expansion of the technical resources of the agency would take place in three stages. In the first stage, the agency would have a centre for processing data supplied by states having observation satellites; in the second stage, the agency would establish data-receiving stations which would be directly linked to these states' satellites; and in the third stage, the agency itself would have the observation satellites required for the performance of its task [77].

[14] The Secretary-General's report of 28 April 1978 on the reduction of military budgets names only five countries—Austria, Canada, New Zealand, Sweden and the USA—as willing unconditionally to participate in a pilot test of the reporting instrument of military expenditures [75].
[15] Alva Myrdal, former Swedish Minister for Disarmament, proposed the creation of such an organization and described its possible functions in an article published in 1974 [76].

The USA announced its readiness to provide assistance, under the auspices of the United Nations or regional organizations, for verifying compliance with arrangements for the disengagement of forces following hostilities, as well as measures agreed between parties at peace. The specific services would include, first, the provision of land-based sensors to monitor movements in potential invasion routes and staging areas, as well as across borders; and, second, assistance with aircraft photo-reconnaissance and associated photo-interpretation [64].

Sweden offered to establish, operate and finance an international seismological data centre on its territory, as an element in a global system monitoring compliance with a comprehensive nuclear test ban treaty [78]. Norway stated that it was willing to contribute to control of a test ban treaty by making available data from the Norwegian Seismic Array (NORSAR), and by assisting in the scientific evaluation of the data [79], while the Federal Republic of Germany proposed its Central Seismological Observatory at Gräfenberg for participation in the international seismic data exchange [80]. Also, Denmark advised that its experts and installations in Greenland might be useful for an international seismic system [29].

To help in developing an international verification system for a convention prohibiting chemical weapons production, the Federal Republic of Germany has invited experts from all the UN member states to visit its chemical plants. The purpose of the invitation is to prove that international on-site inspections within the framework of a chemical weapons ban can be carried out without prejudicing industrial secrets [81].

Finally, Austria proposed to ascertain the views of governments on different aspects of verification in order to arrive at some agreed concepts and definitions [5p].[16] However, many delegations were of the opinion that verification ought to be considered in close conjunction with specific disarmament measures.

Confidence-building measures

To render easier the process of disarmament, the Final Document recommends the following confidence-building measures: prevention of attacks which may occur as a result of an accident, miscalculation or failure of communications among governments; and assessment by states of possible implications of their military research and development for the existing agreements as well as for further efforts in the field of disarmament (paragraph 93).

[16] The concept of verification and its use in disarmament and arms limitation agreements was examined in a background paper, entitled *Disarmament and Verification*, prepared by the UN Secretariat at the request of the Preparatory Committee of the Special Session [82].

In order to prevent unintended wars, several powers have already established special communications links for direct contact at the highest governmental level. Such 'hot lines' are now prescribed by the Final Document also for other governments, especially in areas of tension.

With regard to military research and development, Norway suggested that states should adopt a procedure by which budget requests for major weapons and weapon systems should be accompanied by an evaluation of the impact of such weapons and systems on arms control and disarmament [83]. A country known already to have introduced a procedure of this kind is the USA, where requests to Congress for authorization or appropriations for programmes of research, development, testing, engineering, construction, deployment or modernization with respect to armaments must include a statement analysing the impact of such programmes on arms control and disarmament policy and negotiations.

The Federal Republic of Germany proposed that certain undertakings be agreed on a regional basis, as a first step towards a world-wide convention on confidence-building measures. These undertakings would include: provision of information on military budgets and the strength and composition of the armed forces, as well as notification of any changes in that composition; exchange of military personnel, including visits of military delegations; notification of military manoeuvres and exchange of observers at the manoeuvres; notification of military movements; and establishment of internationally staffed observation posts and electronic monitoring stations in crisis areas and demilitarized zones [84]. Such measures as notification of major manoeuvres, as well as exchange of observers at manoeuvres, are already carried out in Europe in accordance with the Final Act of the Conference on Security and Co-operation of 1 August 1975.

Romania went even further than the Federal Republic of Germany in suggesting the establishment of 15- to 20-km security zones at the frontiers of states, from which troops and armaments would be withdrawn [40].

Studies

The UN Secretary-General was requested by the Special Session to submit periodic reports on the economic and social consequences of the arms race and on its effects on world peace and security (paragraph 93(*c*) of the Final Document), the last such report having been issued in 1977 [85]. Furthermore, at the initiative of the Nordic countries, an expert study is to be carried out on the relationship between disarmament and development. It is to be made in the context of how disarmament can contribute to the establishment of a new international economic order, and is to place special emphasis on the desirability and feasibility of a reallocation of resources used for military purposes to economic and social development, particularly for the benefit of the developing countries (paragraphs 94 and 95). It was also decided that the study of the interrelationship between disarmament and international security, requested by the General Assembly in 1977 [86], should be submitted in 1979 (paragraph 97).[17] Other proposals for studies, not specifically recommended by the Special Session, were referred to appropriate disarmament bodies.

The Secretary-General was asked to set up an advisory board of eminent persons to advise him on various aspects of studies to be made under UN auspices in the field of disarmament and arms limitation, including a programme of such studies (paragraph 124).

Information, education and training

With a view to mobilizing world public opinion on behalf of disarmament, the Special Session recommended that governmental and non-governmental information organs and those of the UN and its specialized agencies should give priority to the preparation and distribution of material relating to the danger of the arms race as well as to the disarmament efforts and negotiations on specific disarmament measures (paragraph 100 of the Final Document).

The UN Centre for Disarmament was asked to intensify its information activities concerning the armaments race and disarmament, while the UN Educational, Scientific and Cultural Organization (UNESCO) was urged to intensify its activities aimed at facilitating research and publications on disarmament (paragraph 103). The role of non-governmental organizations in the process of disseminating information about developments in the disarmament field was recognized, and closer liaison between them and the United Nations was requested (paragraph 104). This is discussed further in chapter 18.

Governments and international organizations, both governmental and non-governmental, were called upon to develop programmes of education for disarmament and peace studies, in order to contribute to a greater understanding and awareness of the problems created by the armaments race and of the need for disarmament (paragraph 106). The Special Session urged UNESCO to step up its programme for the development of disarmament education, as a distinct field of study, through the preparation of teachers' guides, textbooks, readers and

[17] A preliminary examination of the link between international security and disarmament was prepared by the UN Secretary-General for the Special Session [87].

audio-visual materials. It further recommended that measures should be taken by states to encourage the incorporation of such materials in the curricula of their educational institutes (paragraph 107). At the initiative of Nigeria [88], the Special Session decided to establish a programme of fellowships on disarmament, in order to promote relevant expertise, particularly in the developing countries (paragraph 108).

France suggested that an autonomous institute should be established, within the framework of the United Nations, to conduct theoretical and applied research on questions relating to disarmament and security. The programme of the institute would include such topics as military technologies, comparative studies of various control systems for disarmament agreements, the concept of the right to security and its regional applications, and so on [89].

A proposal for setting up a polemological agency was put forward by Uruguay. The objectives of the agency would include, among others: promotion of multidisciplinary research on peace; study of aggressivity and its causes; research on, and analysis of, all conflicts; and preparation of plans for the strengthening of world peace and international security [90].

The UN Secretary-General called upon nations to devote $1 million for every $1 000 million currently spent on arms to strengthen their disarmament education or information activities, to increase their research capacities, or to further the work of international organizations [91]. Sweden decided to place 1 million Swedish crowns at the disposal of the Secretary-General to help to finance the UN study on the relationship between disarmament and development [25].

The Special Session proclaimed the week starting 24 October, the day commemorating the entry into force of the UN Charter, as a week devoted annually to fostering the objectives of disarmament (paragraph 102 of the Final Document).

Maintenance of peace

The Final Document stipulates that progress in disarmament should be accompanied by strengthening the institutions for maintaining peace and the settlement of international disputes by peaceful means (paragraph 110).

In a memorandum of 8 June 1978, 14 countries—Belgium, Canada, Denmark, FR Germany, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Sweden, the UK and the USA—suggested that ways should be considered in which threats to the peace could be anticipated and peaceful solutions promoted, before issues attained the nature of a dispute or conflict. The same memorandum proposed to analyse why the existing mechanisms designed to facilitate the use of various available methods of peaceful settlement of disputes, including those listed in Article 33 of the UN Charter,[18] have been rarely resorted to, and also what measures could be taken to facilitate the ability of the UN Secretary-General to mount effective peace-keeping operations at short notice [92]. One such measure was suggested by the USA, namely, the establishment of a UN peace-keeping reserve to be made up of national contingents trained in UN peace-keeping methods and earmarked by governments for United Nations duty. This reserve would be drawn upon by the Secretary-General whenever the Security Council decided to establish a UN force to maintain international peace and security [93].

IV. Machinery for deliberation and negotiation

The Special Session found it necessary to improve the existing disarmament machinery, which consists of two kinds of body—deliberative and negotiating. While all UN states are represented on the former, the latter, for the sake of convenience, have a restricted membership.

Deliberation

The Final Document postulates that the United Nations, which according to its Charter has primary responsibility for disarmament, should play a more active role in this field. It should encourage all disarmament measures—unilateral, bilateral, regional or multilateral—and be kept informed of all disarmament efforts outside its aegis (paragraph 114). The latter requirement is particularly important, as the most vital negotiations are being held bilaterally or trilaterally among the great powers, without any UN involvement.

The General Assembly, the main deliberative organ of the United Nations, will continue with its task of facilitating the implementation of disarmament measures and will review draft multilateral disarmament treaties submitted for its commendation. Beginning with its thirty-third regular session, the General Assembly will have on its agenda an item on the review of the implementation of the recommendations and decisions of the Special Session (paragraphs 115 and 116). The First Committee of the Assembly, which is a committee of the whole UN

[18] Article 33, paragraph 1 of the Charter reads as follows:
"The parties to any dispute, the continuance of which is likely to endanger the maintenance of international peace and security, shall, first of all, seek a solution by negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their own choice."

membership and which used to deal with a variety of political problems, will in the future deal only with questions of disarmament and related international security questions (paragraph 117).

In addition, the Special Session decided to "establish" (actually to revitalize) the Disarmament Commission, which was originally set up in 1952 [94] and had remained inactive since 1965. The function of this subsidiary organ of the General Assembly, to be composed of all UN members, is to consider and make recommendations on various problems in the field of disarmament and to follow up the relevant decisions of the Special Session. It will discuss *inter alia* "the elements of a comprehensive programme for disarmament" to be submitted as recommendations to the General Assembly and, through it, to the negotiating body. The decisions of the Disarmament Commission on substantive issues are to be adopted by consensus, "in so far as possible" (paragraph 118).

It seems that the need for a Disarmament Commission, as a deliberative body supplementary to the General Assembly, has not been adequately substantiated. The First Committee of the General Assembly, relieved from discussing non-disarmament items, will have enough time to consider the principles governing disarmament, to work out appropriate recommendations, and to review the implementation of the decisions adopted by the Assembly, in accordance with the obligations spelled out in Article 11 of the UN Charter. However, the Disarmament Commission could perhaps usefully perform the function of examining and possibly amending texts agreed in the multilateral negotiating body before they are submitted to the General Assembly for commendation. Thereby, the requirement expressed in the Final Document that draft multilateral disarmament conventions should be subjected to the "normal procedures applicable in the law of treaties" (paragraph 116) could be better met—that is, they should not be presented to UN members for approval on a take-it-or-leave-it basis, as was sometimes the case in the past.

Negotiation

More extensive modifications were introduced in the negotiating machinery (paragraph 120 of the Final Document). An agreement was reached that the 31-member Conference of the Committee on Disarmament (CCD) would be replaced, as of January 1979, by an enlarged Committee on Disarmament, open for the nuclear weapon states[19] and for 32–35 other states. The latter states, subsequently chosen in consultation

[19] Yugoslavia interprets this provision as applying to the "five existing nuclear-weapon states only" [5q].

with the President of the General Assembly, as announced in mid-September 1978, are as follows: Algeria, Argentina, Australia, Belgium, Brazil, Bulgaria, Burma, Canada, Cuba, Czechoslovakia, Egypt, Ethiopia, the German Democratic Republic, the Federal Republic of Germany, Hungary, India, Indonesia, Iran, Italy, Japan, Kenya, Mexico, Mongolia, Morocco, the Netherlands, Nigeria, Pakistan, Peru, Poland, Romania, Sri Lanka, Sweden, Venezuela, Yugoslavia and Zaire.

The newcomer states are Algeria, Australia, Belgium, Cuba, Indonesia, Kenya, Sri Lanka and Venezuela, but the membership is to be reviewed at "regular intervals", with the understanding [95] that the choice of committee members will be preceded by consultations between UN member states and the President of the General Assembly. Greece [5r] and Turkey [5s] interpreted 'regular intervals' to be no longer than three years. New Zealand suggested that the first review should be completed at the second UN Special Session on disarmament [5t], while the United Republic of Cameroon was of the opinion that the rotation of membership should take place each year or every second year [5u]. Nevertheless, there seemed to be a common feeling that the system of rotation should take into account the need for continuity as well as the special responsibilities and roles of certain states in the field of disarmament.

In spite of general recognition that the United Nations must play a central role in the sphere of disarmament, the Committee on Disarmament was not formally established as a UN body. Nonetheless, the UN Secretary-General will appoint the Secretary of the Committee who will act as his personal representative. Moreover, in adopting its agenda, the Committee is to take into account the recommendations made to it by the General Assembly, and submit reports to the Assembly, but it is not formally bound by the decisions of, or responsible to, this principal organ of the United Nations. Like its predecessor, the Committee will set its own rules of procedure and conduct its work by consensus. A major change has occurred with regard to the chairmanship of the Committee. The US–Soviet co-chairmanship, which was criticized in the CCD, mainly because it impeded the participation of China and France in the work of the CCD, has now been abolished. In the new body the chairmanship will rotate among all its members on a monthly basis.

Non-members of the Committee on Disarmament will have the right to submit written proposals or working documents on measures of disarmament that are the subject of negotiation, and to participate in the discussion of such proposals or documents. They may also be invited to express views when issues of particular concern to them are under discussion. And, as distinct from the CCD, the Committee on Disarmament will hold its plenary meetings open to the public.

UN Centre for Disarmament

The Special Session recommended that the UN Centre for Disarmament be strengthened and its research and information functions extended. The Centre was requested to take account of the possibilities offered by specialized agencies and other institutions and programmes within the UN system with regard to studies and information on disarmament. It was also decided that the Centre should increase contacts with non-governmental organizations and research institutions in view of the role they play in the field of disarmament (paragraph 123 of the Final Document).

Other disarmament institutions

Italy suggested that the UN Security Council should review the implementation of its responsibilities in the field of the regulation of armaments in accordance with the UN Charter,[20] and consider the desirability of establishing subsidiary organs for specific disarmament purposes, beginning with a committee, divided into regional subcommittees, to control international transfers of conventional weapons [65b].

Sri Lanka put forward a proposal for the establishment of a World Disarmament Authority, as a permanent organ of the United Nations. The first task of this body would be to collect and collate existing information relating to armaments, their production, distribution, transfers and application, while its studies could include the question of military budgets and their bearing on disarmament and related subjects. Moreover, the Authority would be entrusted with monitoring disarmament agreements; it would help to develop proposals and programmes for disarmament, and provide countries with specialized knowledge on technical aspects of disarmament. Finally, within the context of general and complete disarmament, the Authority would be entrusted with responsibility for controlling and regulating the production and distribution of armaments and determining the purposes for which they are required [96]. The Netherlands also saw the need for an international disarmament organization, mainly for the purpose of verifying the implementation of disarmament agreements [65c]. (The French proposal for an international satellite monitoring agency is described above in the section on the programme of action.)

It is a moot question whether a new world institution for disarmament is actually needed, at least at present. Such functions as collection and dissemination of relevant information or studies of

[20] Article 26 of the UN Charter stipulates that the Security Council shall be responsible for formulating plans to be submitted to the members of the United Nations for the establishment of a system for the regulation of armaments.

different aspects of disarmament are already performed or should be performed or directed by the recently strengthened UN Centre for Disarmament, while elaborating disarmament programmes is the primary task of the existing deliberative and negotiating organs.

As far as verification is concerned, there does not seem to be much that an omnibus organization could do with respect to the multilateral arms control agreements in force. New multilateral treaties, such as a convention prohibiting chemical weapons or a comprehensive nuclear test ban treaty, will require specialized expert bodies applying their own rules in handling verification issues, and choosing methods of control adapted to the type of activity prohibited and the technical means available. Maximum use will probably be made of UN-affiliated and other authoritative international agencies dealing with related peaceful activities, as is now the case with the International Atomic Energy Agency charged with monitoring the observance of the NPT. Here again, the UN Centre could assume the role of coordinator of operations conducted by bodies involved in the verification of specific measures. In regional agreements the parties are likely to rely on regional rather than world-wide verification arrangements, while in US–Soviet relations a standing Consultative Committee has been set up to consider questions of compliance, organize the exchange of information and discuss proposals for increasing the viability of the strategic arms control treaties. Only a comprehensive and general disarmament arrangement might require a comprehensive treatment of verification on a global scale, while control over the remaining armaments would be the responsibility of a world political body.

The Final Document stipulates that, at the "earliest appropriate time", a world disarmament conference should be held (paragraph 122). However, in view of the near-universality of the United Nations, and considering that a new disarmament machinery has been set in motion both for deliberation and negotiation, that a second UN Special Session devoted to disarmament will soon be convened (paragraph 119), and that participation in such a Session can be at a high political level, it is not clear what a new international parley could achieve that a UN General Assembly Special Session could not. In any event, no treaty obligations can be imposed upon states by an international meeting, be it a UN Assembly or a conference, bypassing national constitutional procedures.

V. Assessment

The Special Session was convened due to the initiative of non-aligned states, and in spite of the initial reluctance of the great powers. The idea was to involve all countries in a disarmament debate with a view to working out a generally acceptable disarmament strategy, to improving the machinery for discussing and negotiating disarmament, and to stimulating public interest in favour of disarmament.

The Special Session proved to be the largest international meeting in history devoted exclusively to disarmament matters. The problems were discussed in greater depth than at regular UN General Assemblies. It is especially noteworthy that for the first time all nuclear weapon powers, including China and France, took an active part in this type of deliberation. However, the atmosphere of the Session was adversely affected by the state of relations between the USA and the USSR, which deteriorated early in 1978 and which probably accounted for the absence from the Session of the leaders of these two great powers responsible for the major part of the world military effort.

The Final Document adopted by the Special Session marks progress in certain respects, mainly in that it deals with conventional disarmament and arms transfers in parallel with nuclear disarmament (the latter being rightly accorded the highest priority), and in that it attaches due importance to security guarantees for non-nuclear weapon states. In addition, ground has been prepared for studies to analyse various ideas and proposals generated by the debate, which in time may come to fruition.

However, as regards the essential problems of the arms race, the Special Session did not live up to expectations. The USA and the USSR were unable to report an agreement on the further limitation of their strategic armaments. The expected treaty on the cessation of all nuclear weapon tests did not materialize. Neither was any progress made in banning chemical weapons. And on the question of non-proliferation of nuclear weapons, the Final Document is weaker than many UN resolutions adopted in previous years. The basic differences of approach of individual states and political blocs remained almost intact. They were merely skilfully wrapped up in ambiguous phraseology, or sidetracked by frequent references to 'national security', disguising the continuing reluctance to subordinate short-term national considerations to longer-range global interests.

A serious deficiency of the Final Document lies in the fact that it continues to deal with disarmament in a piecemeal manner. What is called a programme of action is no more than a loose catalogue of measures, not necessarily related to each other, and not always following a logical sequence. Although a comprehensive programme of disarmament is mentioned, the meaning of 'comprehensive' is not defined, and the 'programme' itself remains to be developed. In other words, the Session did not succeed in working out a coherent strategy for disarmament. At best, it may have laid a foundation for such a strategy. Its Final Document should be viewed rather as a new, enlarged frame of reference for the negotiators. This in itself may be of some importance, considering that the reform of the disarmament negotiating machinery, which has now become more representative and better structured, may give a fresh impetus to the process of negotiations.

The Special Session induced many governments to develop and articulate their disarmament policies. It also enhanced the role of non-aligned and other smaller states in dealing with world affairs. One of its accomplishments was that it helped non-governmental organizations (NGOs) to mobilize public opinion for the cause of disarmament. For the first time in UN history, representatives from these organizations as well as research institutions could address the General Assembly on issues of universal importance. The Session recognized the value of non-governmental scientific research in the field of armaments and disarmament, as well as the need for educational programmes for disarmament.

On balance, the Special Session was a worthwhile exercise. If anything, it highlighted the dangers and the wastefulness of armaments and sharpened the sense of urgency with regard to disarmament. As stated in the Final Document, it can mark the "beginning of a new phase of the efforts of the United Nations in the field of disarmament" (paragraph 128). The international disarmament debate will continue in different fora and at different levels, providing opportunities for the majority of nations to press the protagonists in the arms race towards halting and eventually reversing it.

References

1. UN document A/RES/S-10/2.
2. Report of the Preparatory Committee for the Special Session of the General Assembly Devoted to Disarmament, Vol. 1, General Assembly Official Records: Tenth Special Session, Supplement No. 1 (A/S-10/1), paragraph 26.
3. UN General Assembly Resolution 32/88B.
4. UN document A/S-10/PV.1, pp. 38–40.
5. UN document A/S-10/PV.27.
   (a) —, p. 97.
   (b) —, p. 163.
   (c) —, p. 166.
   (d) —, p. 42.
   (e) —, p. 153.
   (f) —, p. 202.
   (g) —, p. 112.

(h) —, pp. 68–69.
(i) —, pp. 193–95.
(j) —, p. 52.
(k) —, p. 201.
(m)—, p. 87.
(n) —, p. 51.
(o) —, pp. 198–200.
(p) —, p. 56.
(q) —, pp. 93–95.
(r) —, p. 167.
(s) —, p. 197.
(t) —, p. 142.
(u) —, pp. 158–60.

6. UN document A/RES/2602E (XXIV).
7. Disarmament Conference document ENDC/2/Add. 1.
8. Disarmament Conference document ENDC/30/Add. 1 and 2.
9. UN document A/S-10/AC.1/17.
10. UN document A/S-10/PV.3.
    (a) —, pp. 23–25.
11. Official Records of the UN General Assembly, Fifteenth Session, A/4879.
12. *World Armaments and Disarmament, SIPRI Yearbook 1977* (Almqvist & Wiksell, Stockholm, 1977, Stockholm International Peace Research Institute), pp. 16–17.
13. Letter from Presidential Adviser McCloy to Deputy Foreign Minister Zorin, Verification of retained forces and armaments, 20 September 1961, UN document A/4880, 20 September 1961.
14. Letter from Deputy Foreign Minister Zorin to Presidential Adviser McCloy, 20 September 1961; UN document A/4887, 25 September 1961.
15. UN document A/S-10/AC.1/4.
16. UN document A/S-10/AC.1/18.
17. UN document A/S-10/PV.6.
18. UN document A/S-10/AC.1/L.6.
19. *US Department of State Bulletin*, 11 May 1964.
20. Disarmament Conference document ENDC/131.
21. UN document A/S-10/PV.24.
    (a) —, p. 12.
22. UN document A/S-10/AC.1/L.10.
23. UN document A/S-10/AC.1/L.12.
24. UN document A/S-10/AC.1/L.13.
25. UN document A/S-10/PV.2.
    (a) —, p. 23.
26. UN document A/S-10/PV.5.
    (a) —, p. 37.
27. UN document A/S-10/AC.1/L.11.
28. UN document A/RES/1653(XVI).
29. UN document A/S-10/PV.7.

30. UN Security Council Resolution No. 255.
31. UN document A/S-10/AC.1/30.
32. UN document A/S-10/PV.26.
33. UN document A/RES/3472B (XXX).
34. UN document A/S-10/AC.1/PV.16.
35. UN document A/S-10/AC.1/10.
36. UN document A/RES/2832 (XXVI).
37. UN document A/S-10/PV.20.
38. UN document A/S-10/AC.1/37.
    (a) —, para. 72.
    (b) —, para. 126.
39. UN document A/S-10/AC.1/23.
40. UN document A/S-10/14.
41. UN document A/C.1/32/7.
42. Disarmament Conference document CCD/578.
43. Disarmament Conference document CCD/559.
44. UN General Assembly Resolution 32/87D.
45. UN document A/S-10/8 and Add. 1 and 2.
46. *New York Times*, 13 June 1978.
47. UN document A/10044.
48. UN document A/S-10/AC.1/34.
49. UN document A/S-10/AC.1/39.
50. *Washington Post*, 26 October 1978.
51. UN document A/S-10/PV.12.
52. UN document A/S-10/PV.15.
53. UN document A/S-10/PV.9.
54. UN document A/S-10/PV.14.
55. UN document A/S-10/AC.1/22.
56. UN document A/S-10/AC.1/6.
57. UN document A/S-10/AC.1/3.
58. UN document A/S-10/AC.1/L.1/Rev.1.
59. *Disarmament Times*, No. 15, New York, 9 June 1978.
60. UN document A/S-10/23, Part I.
61. UN document A/L.701.
62. Conference document CF/DOC/13, 21 July 1955, The Geneva Conference of Heads of Government, 18–23 July 1955 (US Department of State publication 6046, 1955), pp. 60–62.
63. UN document A/S-10/AC.1/28.
64. UN document A/S-10/AC.1/PV.9.
65. UN document A/S-10/AC.1/37.
    (a) —, para. 141.
    (b) —, para. 179.
    (c) —, para. 186.
66. UN document A/S-10/PV.17.
67. UN document A/S-10/AC.1/L.3.
68. UN document A/S-10/AC.1/21.
69. UN document A/S-10/AC.1/40.

70. UN document A/S-10/AC.1/5.
71. Permanent Mission of Iran to the United Nations, Press-Release No. 1-2537, New York, 14 June 1978.
72. UN document A/S-10/AC.1/15.
73. UN document A/S-10/AC.1/33.
74. UN General Assembly Resolution 32/85.
75. UN document A/S-10/6.
76. *Scientific American*, Vol. 231, No. 4, October 1974.
77. UN document A/S-10/AC.1/7.
78. UN document A/S-10/AC.1/19.
79. UN document A/S-10/AC.1/32.
80. UN document A/S-10/AC.1/12.
81. UN document A/S-10/AC.1/13.
82. UN document A/AC.187/109.
83. UN document A/S-10/AC.1/31.
84. UN document A/S-10/AC.1/20.
85. UN Publication, Sales No. E.78.IX.1.
86. UN General Assembly Resolution 32/87C.
87. UN document A/S-10/7.
88. UN document A/S-10/AC.1/11.
89. UN document A/S-10/AC.1/8.
90. UN document A/S-10/AC.1/25.
91. UN document A/S-10/PV.1.
92. UN document A/S-10/AC.1/26.
93. UN document A/S-10/AC.1/24.
94. UN document A/RES/502(VI).
95. UN document A/S-10/AC.1/PV.16, p. 32.
96. UN document A/S-10/AC.1/9/Add.1.

Appendix 11A

Final Document of the Tenth Special Session of the General Assembly

The General Assembly,

Alarmed by the threat to the very survival of mankind posed by the existence of nuclear weapons and the continuing arms race, and recalling the devastation inflicted by all wars,

Convinced that disarmament and arms limitation, particularly in the nuclear field, are essential for the prevention of the danger of nuclear war and the strengthening of international peace and security and for the economic and social advancement of all peoples, thus facilitating the achievement of the new international economic order,

Having resolved to lay the foundations of an international disarmament strategy which, through co-ordinated and persevering efforts in which the United Nations should play a more effective role, aims at general and complete disarmament under effective international control,

Adopts the following Final Document of this special session of the General Assembly devoted to disarmament:

FINAL DOCUMENT OF THE TENTH SPECIAL SESSION
OF THE GENERAL ASSEMBLY

CONTENTS

I. Introduction

1. The attainment of the objective of security, which is an inseparable element of peace, has always been one of the most profound aspirations of humanity. States have for a long time sought to maintain their security through the possession of arms. Admittedly, their survival has, in certain cases, effectively depended on whether they could count on appropriate means of defence. Yet the accumulation of weapons, particularly nuclear weapons, today constitutes much more a threat than a protection for the future of mankind. The time has therefore come to put an end to this situation, to abandon the use of force in international relations and to seek security in disarmament, that is to say, through a gradual but effective process beginning with a reduction in the present level of armaments. The ending of the arms race and the achievement of real disarmament are tasks of primary importance and urgency. To meet this historic challenge is in the political and economic interests of all the nations and peoples of the world as well as in the interests of ensuring their genuine security and peaceful future.

2. Unless its avenues are closed, the continued arms race means a growing threat to

international peace and security and even to the very survival of mankind. The nuclear and conventional arms build-up threatens to stall the efforts aimed at reaching the goals of development, to become an obstacle on the road of achieving the new international economic order and to hinder the solution of other vital problems facing mankind.

3. The dynamic development of détente, encompassing all spheres of international relations in all regions of the world, with the participation of all countries, would create conditions conducive to the efforts of States to end the arms race, which has engulfed the world, thus reducing the danger of war. Progress on détente and progress on disarmament mutually complement and strengthen each other.

4. The Disarmament Decade solemnly declared in 1969 by the United Nations is coming to an end. Unfortunately, the objectives established on that occasion by the General Assembly appear to be as far away today as they were then, or even further because the arms race is not diminishing but increasing and outstrips by far the efforts to curb it. While it is true that some limited agreements have been reached, "effective measures relating to the cessation of the nuclear arms race at an early date and to nuclear disarmament" continue to elude man's grasp. Yet the implementation of such measures is urgently required. There has not been any real progress either that might lead to the conclusion of a treaty on general and complete disarmament under effective international control. Furthermore, it has not been possible to free any amount, however modest, of the enormous resources, both material and human, which are wasted on the unproductive and spiralling arms race and which should be made available for the purpose of economic and social development, especially since such a race "places a great burden on both the developing and the developed countries".

5. The Members of the United Nations are fully aware of the conviction of their peoples that the question of general and complete disarmament is of utmost importance and that peace, security and economic and social development are indivisible, and they have therefore recognized that the corresponding obligations and responsibilities are universal.

6. Thus a powerful current of opinion has gradually formed, leading to the convening of what will go down in the annals of the United Nations as the first special session of the General Assembly devoted entirely to disarmament.

7. The outcome of this special session, whose deliberations have to a large extent been facilitated by the five sessions of the Preparatory Committee which preceded it, is the present Final Document. This introduction serves as a preface to the document which comprises also the following three sections: a Declaration, a Programme of Action and recommendations concerning the international machinery for disarmament negotiations.

8. While the final objective of the efforts of all States should continue to be general and complete disarmament under effective international control, the immediate goal is that of the elimination of the danger of a nuclear war and the implementation of the measures to halt and reverse the arms race and clear the path towards lasting peace. Negotiations on the entire range of those issues should be based on the strict observance of the purposes and principles enshrined in the Charter of the United Nations, with full recognition of the role of the United Nations in the field of disarmament and reflecting the vital interest of all the peoples of the world in this sphere. The aim of the Declaration is to review and assess the existing situation, outline the objectives and the priority tasks and set forth fundamental principles for disarmament negotiations.

9. For disarmament—the aims and purposes of which the Declaration proclaims—

to become a reality, it was essential to agree on a series of specific disarmament measures, selected by common accord as those on which there is a consensus to the effect that their subsequent realization in the short term appears to be feasible. There is also a need to prepare through agreed procedures a comprehensive disarmament programme. That programme, passing through all the necessary stages, should lead to general and complete disarmament under effective international control. Procedures for watching over the fulfilment of the obligations thus assumed had also to be agreed upon. That is the purpose of the Programme of Action.

10. Although the decisive factor for achieving real measures of disarmament is the "political will" of States, especially of those possessing nuclear weapons, a significant role can also be played by the effective functioning of an appropriate international machinery designed to deal with the problems of disarmament in its various aspects. Consequently, it would be necessary that the two kinds of organs required to that end, the deliberative and the negotiating organs, have the appropriate organization and procedures that would be most conducive to obtaining constructive results. The last section of the Final Document, section IV, has been prepared with that end in view.

II. Declaration

11. Mankind today is confronted with an unprecedented threat of self-extinction arising from the massive and competitive accumulation of the most destructive weapons ever produced. Existing arsenals of nuclear weapons alone are more than sufficient to destroy all life on earth. Failure of efforts to halt and reverse the arms race, in particular the nuclear arms race, increases the danger of the proliferation of nuclear weapons. Yet the arms race continues. Military budgets are constantly growing, with enormous consumption of human and material resources. The increase in weapons, especially nuclear weapons, far from helping to strengthen international security, on the contrary weakens it. The vast stockpiles and tremendous build-up of arms and armed forces and the competition for qualitative refinement of weapons of all kinds, to which scientific resources and technological advances are diverted, pose incalculable threats to peace. This situation both reflects and aggravates international tensions, sharpens conflicts in various regions of the world, hinders the process of détente, exacerbates the differences between opposing military alliances, jeopardizes the security of all States, heightens the sense of insecurity among all States, including the non-nuclear-weapon States, and increases the threat of nuclear war.

12. The arms race, particularly in its nuclear aspect, runs counter to efforts to achieve further relaxation of international tension, to establish international relations based on peaceful coexistence and trust between all States, and to develop broad international co-operation and understanding. The arms race impedes the realization of the purposes, and is incompatible with the principles, of the Charter of the United Nations, especially respect for sovereignty, refraining from the threat or use of force against the territorial integrity or political independence of any State, the peaceful settlement of disputes and non-intervention and non-interference in the internal affairs of States. It also adversely affects the right of peoples freely to determine their systems of social and economic development, and hinders the struggle for self-determination and the elimination of colonial rule, racial or foreign domination or occupation. Indeed, the massive accumulation of armaments and the acquisition of armaments technology by racist régimes, as well as their possible acquisition of nuclear weapons, present a challenging and increasingly dangerous obstacle to a world community faced with the urgent need to disarm. It is, therefore, essential for purposes of disarmament to prevent

any further acquisition of arms or arms technology by such régimes, especially through strict adherence by all States to relevant decisions of the Security Council.

13. Enduring international peace and security cannot be built on the accumulation of weaponry by military alliances nor be sustained by a precarious balance of deterrence or doctrines of strategic superiority. Genuine and lasting peace can only be created through the effective implementation of the security system provided for in the Charter of the United Nations and the speedy and substantial reduction of arms and armed forces, by international agreement and mutual example, leading ultimately to general and complete disarmament under effective international control. At the same time, the causes of the arms race and threats to peace must be reduced and to this end effective action should be taken to eliminate tensions and settle disputes by peaceful means.

14. Since the process of disarmament affects the vital security interests of all States, they must all be actively concerned with and contribute to the measures of disarmament and arms limitation, which have an essential part to play in maintaining and strengthening international security. Therefore the role and responsibility of the United Nations in the sphere of disarmament, in accordance with its Charter, must be strengthened.

15. It is essential that not only Governments but also the peoples of the world recognize and understand the dangers in the present situation. In order that an international conscience may develop and that world public opinion may exercise a positive influence, the United Nations should increase the dissemination of information on the armaments race and disarmament with the full co-operation of Member States.

16. In a world of finite resources there is a close relationship between expenditure on armaments and economic and social development. Military expenditures are reaching ever higher levels, the highest percentage of which can be attributed to the nuclear-weapon States and most of their allies, with prospects of further expansion and the danger of further increases in the expenditures of other countries. The hundreds of billions of dollars spent annually on the manufacture or improvement of weapons are in sombre and dramatic contrast to the want and poverty in which two thirds of the world's population live. This colossal waste of resources is even more serious in that it diverts to military purposes not only material but also technical and human resources which are urgently needed for development in all countries, particularly in the developing countries. Thus, the economic and social consequences of the arms race are so detrimental that its continuation is obviously incompatible with the implementation of the new international economic order based on justice, equity and co-operation. Consequently, resources released as a result of the implementation of disarmament measures should be used in a manner which will help to promote the well-being of all peoples and to improve the economic conditions of the developing countries.

17. Disarmament has thus become an imperative and most urgent task facing the international community. No real progress has been made so far in the crucial field of reduction of armaments. However, certain positive changes in international relations in some areas of the world provide some encouragement. Agreements have been reached that have been important in limiting certain weapons or eliminating them altogether, as in the case of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction[1] and excluding particular areas from the arms race. The fact remains that these agreements relate only to measures of limited restraint while the arms race continues. These partial measures have done little to bring the world closer to the goal of general

[1] Resolution 2826 (XXVI), annex.

and complete disarmament. For more than a decade there have been no negotiations leading to a treaty on general and complete disarmament. The pressing need now is to translate into practical terms the provisions of this Final Document and to proceed along the road of binding and effective international agreements in the field of disarmament.

18. Removing the threat of a world war—a nuclear war—is the most acute and urgent task of the present day. Mankind is confronted with a choice: we must halt the arms race and proceed to disarmament or face annihilation.

19. The ultimate objective of the efforts of States in the disarmament process is general and complete disarmament under effective international control. The principal goals of disarmament are to ensure the survival of mankind and to eliminate the danger of war, in particular nuclear war, to ensure that war is no longer an instrument for settling international disputes and that the use and the threat of force are eliminated from international life, as provided for in the Charter of the United Nations. Progress towards this objective requires the conclusion and implementation of agreements on the cessation of the arms race and on genuine measures of disarmament, taking into account the need of States to protect their security.

20. Among such measures, effective measures of nuclear disarmament and the prevention of nuclear war have the highest priority. To this end, it is imperative to remove the threat of nuclear weapons, to halt and reverse the nuclear arms race until the total elimination of nuclear weapons and their delivery systems has been achieved, and to prevent the proliferation of nuclear weapons. At the same time, other measures designed to prevent the outbreak of nuclear war and to lessen the danger of the threat or use of nuclear weapons should be taken.

21. Along with these measures, agreements or other effective measures should be adopted to prohibit or prevent the development, production or use of other weapons of mass destruction. In this context, an agreement on elimination of all chemical weapons should be concluded as a matter of high priority.

22. Together with negotiations on nuclear disarmament measures, negotiations should be carried out on the balanced reduction of armed forces and of conventional armaments, based on the principle of undiminished security of the parties with a view to promoting or enhancing stability at a lower military level, taking into account the need of all States to protect their security. These negotiations should be conducted with particular emphasis on armed forces and conventional weapons of nuclear-weapon States and other militarily significant countries. There should also be negotiations on the limitation of international transfer of conventional weapons, based in particular on the same principle, and taking into account the inalienable right to self-determination and independence of peoples under colonial or foreign domination and the obligations of States to respect that right, in accordance with the Charter of the United Nations and the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States,[2] as well as the need of recipient States to protect their security.

23. Further international action should be taken to prohibit or restrict for humanitarian reasons the use of specific conventional weapons, including those which may be excessively injurious, cause unnecessary suffering or have indiscriminate effects.

24. Collateral measures in both the nuclear and conventional fields, together with

[2] Resolution 2625 (XXV), annex.

other measures specifically designed to build confidence, should be undertaken in order to contribute to the creation of favourable conditions for the adoption of additional disarmament measures and to further the relaxation of international tension.

25. Negotiations and measures in the field of disarmament shall be guided by the fundamental principles set forth below.

26. All States Members of the United Nations reaffirm their full commitment to the purposes of the Charter of the United Nations and their obligation strictly to observe its principles as well as other relevant and generally accepted principles of international law relating to the maintenance of international peace and security. They stress the special importance of refraining from the threat or use of force against the sovereignty, territorial integrity or political independence of any State, or against peoples under colonial or foreign domination seeking to exercise their right to self-determination and to achieve independence; non-intervention and non-interference in the internal affairs of other States; the inviolability of international frontiers; and the peaceful settlement of disputes, having regard to the inherent right of States to individual and collective self-defence in accordance with the Charter.

27. In accordance with the Charter, the United Nations has a central role and primary responsibility in the sphere of disarmament. In order effectively to discharge this role and facilitate and encourage all measures in this field, the United Nations should be kept appropriately informed of all steps in this field, whether unilateral, bilateral, regional or multilateral, without prejudice to the progress of negotiations.

28. All the peoples of the world have a vital interest in the success of disarmament negotiations. Consequently, all States have the duty to contribute to efforts in the field of disarmament. All States have the right to participate in disarmament negotiations. They have the right to participate on an equal footing in those multilateral disarmament negotiations which have a direct bearing on their national security. While disarmament is the responsibility of all States, the nuclear-weapon States have the primary responsibility for nuclear disarmament and, together with other militarily significant States, for halting and reversing the arms race. It is therefore important to secure their active participation.

29. The adoption of disarmament measures should take place in such an equitable and balanced manner as to ensure the right of each State to security and to ensure that no individual State or group of States may obtain advantages over others at any stage. At each stage the objective should be undiminished security at the lowest possible level of armaments and military forces.

30. An acceptable balance of mutual responsibilities and obligations for nuclear and non-nuclear-weapon States should be strictly observed.

31. Disarmament and arms limitation agreements should provide for adequate measures of verification satisfactory to all parties concerned in order to create the necessary confidence and ensure that they are being observed by all parties. The form and modalities of the verification to be provided for in any specific agreement depend upon and should be determined by the purposes, scope and nature of the agreement. Agreements should provide for the participation of parties directly or through the United Nations system in the verification process. Where appropriate, a combination of several methods of verification as well as other compliance procedures should be employed.

32. All States, in particular nuclear-weapon States, should consider various proposals designed to secure the avoidance of the use of nuclear weapons, and the

prevention of nuclear war. In this context, while noting the declarations made by nuclear-weapon States, effective arrangements, as appropriate, to assure non-nuclear-weapon States against the use or the threat of use of nuclear weapons could strengthen the security of those States and international peace and security.

33. The establishment of nuclear-weapon-free zones on the basis of agreements or arrangements freely arrived at among the States of the zone concerned and the full compliance with those agreements or arrangements, thus ensuring that the zones are genuinely free from nuclear weapons, and respect for such zones by nuclear-weapon States constitute an important disarmament measure.

34. Disarmament, relaxation of international tension, respect for the right to self-determination and national independence, the peaceful settlement of disputes in accordance with the Charter of the United Nations and the strengthening of international peace and security are directly related to each other. Progress in any of these spheres has a beneficial effect on all of them; in turn, failure in one sphere has negative effects on others.

35. There is also a close relationship between disarmament and development Progress in the former would help greatly in the realization of the latter. Therefore resources released as a result of the implementation of disarmament measures should be devoted to the economic and social development of all nations and contribute to the bridging of the economic gap between developed and developing countries.

36. Non-proliferation of nuclear weapons is a matter of universal concern. Measures of disarmament must be consistent with the inalienable right of all States, without discrimination, to develop, acquire and use nuclear technology, equipment and materials for the peaceful use of nuclear energy and to determine their peaceful nuclear programmes in accordance with their national priorities, needs and interests, bearing in mind the need to prevent the proliferation of nuclear weapons. International co-operation in the peaceful uses of nuclear energy should be conducted under agreed and appropriate international safeguards applied on a non-discriminatory basis.

37. Significant progress in disarmament, including nuclear disarmament, would be facilitated by parallel measures to strengthen the security of States and to improve the international situation in general.

38. Negotiations on partial measures of disarmament should be conducted concurrently with negotiations on more comprehensive measures and should be followed by negotiations leading to a treaty on general and complete disarmament under effective international control.

39. Qualitative and quantitative disarmament measures are both important for halting the arms race. Efforts to that end must include negotiations on the limitation and cessation of the qualitative improvement of armaments, especially weapons of mass destruction and the development of new means of warfare so that ultimately scientific and technological achievements may be used solely for peaceful purposes.

40. Universality of disarmament agreements helps create confidence among States. When multilateral agreements in the field of disarmament are negotiated, every effort should be made to ensure that they are universally acceptable. The full compliance of all parties with the provisions contained in such agreements would also contribute to the attainment of that goal.

41. In order to create favourable conditions for success in the disarmament process, all States should strictly abide by the provisions of the Charter of the United Nations, refrain from actions which might adversely affect efforts in the field of disarmament,

and display a constructive approach to negotiations and the political will to reach agreements. There are certain negotiations on disarmament under way at different levels, the early and successful completion of which could contribute to limiting the arms race. Unilateral measures of arms limitation or reduction could also contribute to the attainment of that goal.

42. Since prompt measures should be taken in order to halt and reverse the arms race, Member States hereby declare that they will respect the objectives and principles stated above and make every effort faithfully to carry out the Programme of Action set forth in section III below.

III. Programme of Action

43. Progress towards the goal of general and complete disarmament can be achieved through the implementation of a programme of action on disarmament, in accordance with the goals and principles established in the Declaration on disarmament. The present Programme of Action contains priorities and measures in the field of disarmament that States should undertake as a matter of urgency with a view to halting and reversing the arms race and to giving the necessary impetus to efforts designed to achieve genuine disarmament leading to general and complete disarmament under effective international control.

44. The present Programme of Action enumerates the specific measures of disarmament which should be implemented over the next few years, as well as other measures and studies to prepare the way for future negotiations and for progress towards general and complete disarmament.

45. Priorities in disarmament negotiations shall be: nuclear weapons; other weapons of mass destruction, including chemical weapons; conventional weapons, including any which may be deemed to be excessively injurious or to have indiscriminate effects; and reduction of armed forces.

46. Nothing should preclude States from conducting negotiations on all priority items concurrently.

47. Nuclear weapons pose the greatest danger to mankind and to the survival of civilization. It is essential to halt and reverse the nuclear arms race in all its aspects in order to avert the danger of war involving nuclear weapons. The ultimate goal in this context is the complete elimination of nuclear weapons.

48. In the task of achieving the goals of nuclear disarmament, all the nuclear-weapon States, in particular those among them which possess the most important nuclear arsenals, bear a special responsibility.

49. The process of nuclear disarmament should be carried out in such a way, and requires measures to ensure, that the security of all States is guaranteed at progressively lower levels of nuclear armaments, taking into account the relative qualitative and quantitative importance of the existing arsenals of the nuclear-weapon States and other States concerned.

50. The achievement of nuclear disarmament will require urgent negotiation of agreements at appropriate stages and with adequate measures of verification satisfactory to the States concerned for:

(*a*) Cessation of the qualitative improvement and development of nuclear-weapon systems;

(*b*) Cessation of the production of all types of nuclear weapons and their means of delivery, and of the production of fissionable material for weapons purposes;

(*c*) A comprehensive, phased programme with agreed time-frames, whenever feasible, for progressive and balanced reduction of stockpiles of nuclear weapons and their means of delivery, leading to their ultimate and complete elimination at the earliest possible time.

Consideration can be given in the course of the negotiations to mutual and agreed limitation or prohibition, without prejudice to the security of any State, of any types of nuclear armaments.

51. The cessation of nuclear-weapon testing by all States within the framework of an effective nuclear disarmament process would be in the interest of mankind. It would make a significant contribution to the above aim of ending the qualitative improvement of nuclear weapons and the development of new types of such weapons and of preventing the proliferation of nuclear weapons. In this context the negotiations now in progress on "a treaty prohibiting nuclear-weapon tests, and a protocol covering nuclear explosions for peaceful purposes, which would be an integral part of the treaty," should be concluded urgently and the result submitted for full consideration by the multilateral negotiating body with a view to the submission of a draft treaty to the General Assembly at the earliest possible date. All efforts should be made by the negotiating parties to achieve an agreement which, following endorsement by the General Assembly, could attract the widest possible adherence. In this context, various views were expressed by non-nuclear-weapon States that, pending the conclusion of this treaty, the world community would be encouraged if all the nuclear-weapon States refrained from testing nuclear weapons. In this connexion, some nuclear-weapon States expressed different views.

52. The Union of Soviet Socialist Republics and the United States of America should conclude at the earliest possible date the agreement they have been pursuing for several years in the second series of the strategic arms limitation talks. They are invited to transmit in good time the text of the agreement to the General Assembly. It should be followed promptly by further strategic arms limitation negotiations between the two parties, leading to agreed significant reductions of; and qualitative limitations on, strategic arms. It should constitute an important step in the direction of nuclear disarmament and, ultimately, of establishment of a world free of such weapons.

53. The process of nuclear disarmament described in the paragraph on this subject should be expedited by the urgent and vigorous pursuit to a successful conclusion of ongoing negotiations and the urgent initiation of further negotiations among the nuclear-weapon States.

54. Significant progress in nuclear disarmament would be facilitated both by parallel political or international legal measures to strengthen the security of States and by progress in the limitation and reduction of armed forces and conventional armaments of the nuclear-weapon States and other States in the regions concerned.

55. Real progress in the field of nuclear disarmament could create an atmosphere conducive to progress in conventional disarmament on a world-wide basis.

56. The most effective guarantee against the danger of nuclear war and the use of nuclear weapons is nuclear disarmament and the complete elimination of nuclear weapons.

57. Pending the achievement of this goal, for which negotiations should be

vigorously pursued, and bearing in mind the devastating results which nuclear war would have on belligerents and non-belligerents alike, the nuclear-weapon States have special responsibilities to undertake measures aimed at preventing the outbreak of nuclear war, and of the use of force in international relations, subject to the provisions of the Charter of the United Nations, including the use of nuclear weapons.

58. In this context all States, in particular nuclear-weapon States, should consider as soon as possible various proposals designed to secure the avoidance of the use of nuclear weapons, the prevention of nuclear war and related objectives, where possible through international agreement, and thereby ensure that the survival of mankind is not endangered. All States should actively participate in efforts to bring about conditions in international relations among States in which a code of peaceful conduct of nations in international affairs could be agreed and which would preclude the use or threat of use of nuclear weapons.

59. In the same context, the nuclear-weapon States are called upon to take steps to assure the non-nuclear-weapon States against the use or threat of use of nuclear weapons. The General Assembly notes the declarations made by the nuclear-weapon States and urges them to pursue efforts to conclude, as appropriate, effective arrangements to assure non-nuclear-weapon States against the use or threat of use of nuclear weapons.

60. The establishment of nuclear-weapon-free zones on the basis of arrangements freely arrived at among the States of the region concerned constitutes an important disarmament measure.

61. The process of establishing such zones in different parts of the world should be encouraged with the ultimate objective of achieving a world entirely free of nuclear weapons. In the process of establishing such zones, the characteristics of each region should be taken into account. The States participating in such zones should undertake to comply fully with all the objectives, purposes and principles of the agreements or arrangements establishing the zones, thus ensuring that they are genuinely free from nuclear weapons.

62. With respect to such zones, the nuclear-weapon States in turn are called upon to give undertakings, the modalities of which are to be negotiated with the competent authority of each zone, in particular:

(*a*) To respect strictly the status of the nuclear-weapon-free zone;

(*b*) To refrain from the use or threat of use of nuclear weapons against the States of the zone.

63. In the light of existing conditions, and without prejudice to other measures which may be considered in other regions, the following measures are especially desirable:

(*a*) Adoption by the States concerned of all relevant measures to ensure the full application of the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco),[3] taking into account the views expressed at the tenth special session on the adherence to it;

(*b*) Signature and ratification of the Additional Protocols of the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco) by the States entitled to become parties to those instruments which have not yet done so;

[3] United Nations, *Treaty Series*, vol. 634, No. 9068.

(*c*) In Africa, where the Organization of African Unity has affirmed a decision for the denuclearization of the region, the Security Council of the United Nations shall take appropriate effective steps whenever necessary to prevent the frustration of this objective;

(*d*) The serious consideration of the practical and urgent steps, as described in the paragraphs above, required for the implementation of the proposal to establish a nuclear-weapon-free zone in the Middle East, in accordance with the relevant General Assembly resolutions, where all parties directly concerned have expressed their support for the concept and where the danger of nuclear-weapon proliferation exists. The establishment of a nuclear-weapon-free zone in the Middle East would greatly enhance international peace and security. Pending the establishment of such a zone in the region, States of the region should solemnly declare that they will refrain on a reciprocal basis from producing, acquiring or in any other way possessing nuclear weapons and nuclear explosive devices and from permitting the stationing of nuclear weapons on their territory by any third party, and agree to place all their nuclear activities under International Atomic Energy Agency safeguards. Consideration should be given to a Security Council role in advancing the establishment of a nuclear-weapon-free zone in the Middle East;

(*e*) All States in the region of South Asia have expressed their determination to keep their countries free of nuclear weapons. No action should be taken by them which might deviate from that objective. In this context, the question of establishing a nuclear-weapon-free zone in South Asia has been dealt with in several resolutions of the General Assembly, which is keeping the subject under consideration.

64. The establishment of zones of peace in various regions of the world under appropriate conditions, to be clearly defined and determined freely by the States concerned in the zone, taking into account the characteristics of the zone and the principles of the Charter of the United Nations, and in conformity with international law, can contribute to strengthening the security of States within such zones and to international peace and security as a whole. In this regard, the General Assembly notes the proposals for the establishment of zones of peace, *inter alia*, in:

(*a*) South-East Asia where States in the region have expressed interest in the establishment of such a zone, in conformity with their views;

(*b*) The Indian Ocean, taking into account the deliberations of the General Assembly and its relevant resolutions and the need to ensure the maintenance of peace and security in the region.

65. It is imperative, as an integral part of the effort to halt and reverse the arms race, to prevent the proliferation of nuclear weapons. The goal of nuclear non-proliferation is on the one hand to prevent the emergence of any additional nuclear-weapon States besides the existing five nuclear-weapon States, and on the other progressively to reduce and eventually eliminate nuclear weapons altogether. This involves obligations and responsibilities on the part of both nuclear-weapon States and non-nuclear-weapon States, the former undertaking to stop the nuclear arms race and to achieve nuclear disarmament by urgent application of the measures outlined in the relevant paragraphs of this Final Document, and all States undertaking to prevent the spread of nuclear weapons.

66. Effective measures can and should be taken at the national level and through international agreements to minimize the danger of the proliferation of nuclear

weapons without jeopardizing energy supplies or the development of nuclear energy for peaceful purposes. Therefore, the nuclear-weapon States and the non-nuclear-weapon States should jointly take further steps to develop an international consensus of ways and means, on a universal and non-discriminatory basis, to prevent the proliferation of nuclear weapons.

67. Full implementation of all the provisions of existing instruments on non-proliferation, such as the Treaty on the Non-Proliferation of Nuclear Weapons[4] and/or the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco) by States parties to those instruments will be an important contribution to this end. Adherence to such instruments has increased in recent years and the hope has been expressed by the parties that this trend might continue.

68. Non-proliferation measures should not jeopardize the full exercise of the inalienable rights of all States to apply and develop their programmes for the peaceful uses of nuclear energy for economic and social development in conformity with their priorities, interests and needs. All States should also have access to and be free to acquire technology, equipment and materials for peaceful uses of nuclear energy, taking into account the particular needs of the developing countries. International co-operation in this field should be under agreed and appropriate international safeguards applied through the International Atomic Energy Agency on a non-discriminatory basis in order to prevent effectively the proliferation of nuclear weapons.

69. Each country's choices and decisions in the field of the peaceful uses of nuclear energy should be respected without jeopardizing their respective fuel cycle policies or international co-operation, agreements and contracts for the peaceful uses of nuclear energy, provided that the agreed safeguard measures mentioned above are applied.

70. In accordance with the principles and provisions of General Assembly resolution 32/50 of 8 December 1977, international co-operation for the promotion of the transfer and utilization of nuclear technology for economic and social development, especially in the developing countries, should be strengthened.

71. Efforts should be made to conclude the work of the International Nuclear Fuel Cycle Evaluation strictly in accordance with the objectives set out in the final communiqué of its Organizing Conference.[5]

72. All States should adhere to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on 17 June 1925.[6]

73. All States which have not yet done so should consider adhering to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction.

74. States should also consider the possibility of adhering to multilateral agreements concluded so far in the disarmament field which are mentioned below in this section.

75. The complete and effective prohibition of the development, production and stockpiling of all chemical weapons and their destruction represent one of the most urgent measures of disarmament. Consequently, the conclusion of a convention to this end, on which negotiations have been going on for several years, is one of the most

[4] Resolution 2373 (XXII), annex.
[5] See A/C.1/32/7.
[6] League of Nations, *Treaty Series*, vol. XCIV (1929), No. 2138.

urgent tasks of multilateral negotiations. After its conclusion, all States should contribute to ensuring the broadest possible application of the convention through its early signature and ratification.

76. A convention should be concluded prohibiting the development, production, stockpiling and use of radiological weapons.

77. In order to help prevent a qualitative arms race and so that scientific and technological achievements may ultimately be used solely for peaceful purposes, effective measures should be taken to avoid the danger and prevent the emergence of new types of weapons of mass destruction based on new scientific principles and achievements. Efforts should be appropriately pursued aiming at the prohibition of such new types and new systems of weapons of mass destruction. Specific agreements could be concluded on particular types of new weapons of mass destruction which may be identified. This question should be kept under continuing review.

78. The Committee on Disarmament should keep under review the need for a further prohibition of military or any other hostile use of environmental modification techniques in order to eliminate the dangers to mankind from such use.

79. In order to promote the peaceful use of and to avoid an arms race on the sea-bed and the ocean floor and the subsoil thereof, the Committee on Disarmament is requested—in consultation with the States parties to the Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof,[7] and taking into account the proposals made during the 1977 Review Conference of the parties to that Treaty and any relevant technological developments—to proceed promptly with the consideration of further measures in the field of disarmament for the prevention of an arms race in that environment.

80. In order to prevent an arms race in outer space, further measures should be taken and appropriate international negotiations held in accordance with the spirit of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.[8]

81. Together with negotiations on nuclear disarmament measures, the limitation and gradual reduction of armed forces and conventional weapons should be resolutely pursued within the framework of progress towards general and complete disarmament. States with the largest military arsenals have a special responsibility in pursuing the process of conventional armaments reductions.

82. In particular the achievement of a more stable situation in Europe at a lower level of military potential on the basis of approximate equality and parity, as well as on the basis of undiminished security of all States with full respect for security interests and independence of States outside military alliances, by agreement on appropriate mutual reductions and limitations would contribute to the strengthening of security in Europe and constitute a significant step towards enhancing international peace and security. Current efforts to this end should be continued most energetically.

83. Agreements or other measures should be resolutely pursued on a bilateral, regional and multilateral basis with the aim of strengthening peace and security at a lower level of forces, by the limitation and reduction of armed forces and of conventional

[7] Resolution 2660 (XXV), annex.
[8] Resolution 2222 (XXI), annex.

weapons, taking into account the need of States to protect their security, bearing in mind the inherent right of self-defence embodied in the Charter of the United Nations and without prejudice to the principle of equal rights and self-determination of peoples in accordance with the Charter, and the need to ensure balance at each stage and undiminished security of all States. Such measures might include those in the following two paragraphs.

84. Bilateral, regional and multilateral consultations and conferences should be held where appropriate conditions exist with the participation of all the countries concerned for the consideration of different aspects of conventional disarmament, such as the initiative envisaged in the Declaration of Ayacucho subscribed to by eight Latin American countries on 9 December 1974.[9]

85. Consultations should be carried out among major arms supplier and recipient countries on the limitation of all types of international transfer of conventional weapons, based in particular on the principle of undiminished security of the parties with a view to promoting or enhancing stability at a lower military level, taking into account the need of all States to protect their security as well as the inalienable right to self-determination and independence of peoples under colonial or foreign domination and the obligations of States to respect that right, in accordance with the Charter of the United Nations and the Declaration on Principles of International Law concerning Friendly Relations and Co-operation among States.

86. The United Nations Conference on Prohibitions or Restrictions of Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, to be held in 1979, should seek agreement, in the light of humanitarian and military considerations, on the prohibition or restriction of use of certain conventional weapons including those which may cause unnecessary suffering or have indiscriminate effects. The Conference should consider specific categories of such weapons, including those which were the subject-matter of previously conducted discussions.

87. All States are called upon to contribute towards carrying out this task.

88. The result of the Conference should be considered by all States, especially producer States, in regard to the question of the transfer of such weapons to other States.

89. Gradual reduction of military budgets on a mutually agreed basis, for example, in absolute figures or in terms of percentage points, particularly by nuclear-weapon States and other militarily significant States, would be a measure that would contribute to the curbing of the arms race and would increase the possibilities of reallocation of resources now being used for military purposes to economic and social development, particularly for the benefit of the developing countries. The basis for implementing this measure will have to be agreed by all participating States and will require ways and means of its implementation acceptable to all of them, taking account of the problems involved in assessing the relative significance of reductions as among different States and with due regard to the proposals of States on all aspects of reduction of military budgets.

90. The General Assembly should continue to consider what concrete steps should be taken to facilitate the reduction of military budgets, bearing in mind the relevant proposals and documents of the United Nations on this question.

[9] See A/10044, annex.

91. In order to facilitate the conclusion and effective implementation of disarmament agreements and to create confidence, States should accept appropriate provisions for verification in such agreements.

92. In the context of international disarmament negotiations, the problem of verification should be further examined and adequate methods and procedures in this field be considered. Every effort should be made to develop appropriate methods and procedures which are non-discriminatory and which do not unduly interfere with the internal affairs of other States or jeopardize their economic and social development.

93. In order to facilitate the process of disarmament, it is necessary to take measures and pursue policies to strengthen international peace and security and to build confidence among States. Commitment to confidence-building measures could significantly contribute to preparing for further progress in disarmament. For this purpose, measures such as the following, and other measures yet to be agreed upon, should be undertaken:

(*a*) The prevention of attacks which take place by accident, miscalculation or communications failure by taking steps to improve communications between Governments, particularly in areas of tension, by the establishment of "hot lines" and other methods of reducing the risk of conflict;

(*b*) States should assess the possible implications of their military research and development for existing agreements as well as for further efforts in the field of disarmament;

(*c*) The Secretary-General shall periodically submit reports to the General Assembly on the economic and social consequences of the armaments race and its extremely harmful effects on world peace and security.

94. In view of the relationship between expenditure on armaments and economic and social development and the necessity to release real resources now being used for military purposes to economic and social development in the world, particularly for the benefit of the developing countries, the Secretary-General should, with the assistance of a group of qualified governmental experts appointed by him, initiate an expert study on the relationship between disarmament and development. The Secretary-General should submit an interim report on the subject to the General Assembly at its thirty-fourth session and submit the final results to the Assembly at its thirty-sixth session for subsequent action.

95. The expert study should have the terms of reference contained in the report of the *Ad Hoc* Group on the Relationship between Disarmament and Development[10] appointed by the Secretary-General in accordance with General Assembly resolution 32/88 A of 12 December 1977. It should investigate the three main areas listed in the report, bearing in mind the United Nations studies previously carried out. The study should be made in the context of how disarmament can contribute to the establishment of the new international economic order. The study should be forward-looking and policy-oriented and place special emphasis on both the desirability of a reallocation, following disarmament measures, of resources now being used for military purposes to economic and social development, particularly for the benefit of the developing countries, and the substantive feasibility of such a reallocation. A principal aim should be to produce results that could effectively guide the formulation of practical measures to reallocate those resources at the local, national, regional and international levels.

[10] A/S-10/9, annex.

96. Taking further steps in the field of disarmament and other measures aimed at promoting international peace and security would be facilitated by carrying out studies by the Secretary-General in this field with appropriate assistance from governmental or consultant experts.

97. The Secretary-General shall, with the assistance of consultant experts appointed by him, continue the study of the interrelationship between disarmament and international security requested in Assembly resolution 32/87 C of 12 December 1977 and submit it to the thirty-fourth session of the General Assembly.

98. At its thirty-third and subsequent sessions the General Assembly should determine the specific guidelines for carrying out studies, taking into account the proposals already submitted including those made by individual countries at the special session, as well as other proposals which can be introduced later in this field. In doing so, the Assembly would take into consideration a report on these matters prepared by the Secretary-General.

99. In order to mobilize world public opinion on behalf of disarmament, the specific measures set forth below, designed to increase the dissemination of information about the armaments race and the efforts to halt and reverse it, should be adopted.

100. Governmental and non-governmental information organs and those of the United Nations and its specialized agencies should give priority to the preparation and distribution of printed and audio-visual material relating to the danger represented by the armaments race as well as to the disarmament efforts and negotiations on specific disarmament measures.

101. In particular, publicity should be given to the Final Document of the tenth special session.

102. The General Assembly proclaims the week starting 24 October, the day of the foundation of the United Nations, as a week devoted to fostering the objectives of disarmament.

103. To encourage study and research on disarmament, the United Nations Centre for Disarmament should intensify its activities in the presentation of information concerning the armaments race and disarmament. Also, the United Nations Educational, Scientific and Cultural Organization is urged to intensify its activities aimed at facilitating research and publications on disarmament, related to its fields of competence, especially in developing countries, and should disseminate the results of such research.

104. Throughout this process of disseminating information about developments in the disarmament field of all countries, there should be increased participation by non-governmental organizations concerned with the matter, through closer liaison between them and the United Nations.

105. Member States should be encouraged to ensure a better flow of information with regard to the various aspects of disarmament to avoid dissemination of false and tendentious information concerning armaments, and to concentrate on the danger of escalation of the armaments race and on the need for general and complete disarmament under effective international control.

106. With a view to contributing to a greater understanding and awareness of the problems created by the armaments race and of the need for disarmament, Governments and governmental and non-governmental international organizations are

urged to take steps to develop programmes of education for disarmament and peace studies at all levels.

107. The General Assembly welcomes the initiative of the United Nations Educational, Scientific and Cultural Organization in planning to hold a world congress on disarmament education and, in this connexion, urges that organization to step up its programme aimed at the development of disarmament education as a distinct field of study through the preparation, *inter alia*, of teachers' guides, textbooks, readers and audio-visual materials. Member States should take all possible measures to encourage the incorporation of such materials in the curricula of their educational institutes.

108. In order to promote expertise in disarmament in more Member States, particularly in the developing countries, the General Assembly decides to establish a programme of fellowships on disarmament. The Secretary-General, taking into account the proposal submitted to the special session, should prepare guidelines for the programme. He should also submit the financial requirements of twenty fellowships to the General Assembly at its thirty-third session for inclusion in the regular budget of the United Nations, bearing in mind the savings that can be made within the existing budgetary appropriations.

109. Implementation of these priorities should lead to general and complete disarmament under effective international control, which remains the ultimate goal of all efforts exerted in the field of disarmament. Negotiations on general and complete disarmament shall be conducted concurrently with negotiations on partial measures of disarmament. With this purpose in mind, the Committee on Disarmament will undertake the elaboration of a comprehensive programme of disarmament encompassing all measures thought to be advisable in order to ensure that the goal of general and complete disarmament under effective international control becomes a reality in a world in which international peace and security prevail and in which the new international economic order is strengthened and consolidated. The comprehensive programme should contain appropriate procedures for ensuring that the General Assembly is kept fully informed of the progress of the negotiations including an appraisal of the situation when appropriate and, in particular, a continuing review of the implementation of the programme.

110. Progress in disarmament should be accompanied by measures to strengthen institutions for maintaining peace and the settlement of international disputes by peaceful means. During and after the implementation of the programme of general and complete disarmament, there should be taken, in accordance with the principles of the Charter of the United Nations, the necessary measures to maintain international peace and security, including the obligation of States to place at the disposal of the United Nations agreed manpower necessary for an international peace force to be equipped with agreed types of armaments. Arrangements for the use of this force should ensure that the United Nations can effectively deter or suppress any threat or use of arms in violation of the purposes and principles of the United Nations.

111. General and complete disarmament under strict and effective international control shall permit States to have at their disposal only those non-nuclear forces, armaments, facilities and establishments as are agreed to be necessary to maintain internal order and protect the personal security of citizens and in order that States shall support and provide agreed manpower for a United Nations peace force.

112. In addition to the several questions dealt with in this Programme of Action, there are a few others of fundamental importance, on which, because of the complexity

of the issues involved and the short time at the disposal of the special session, it has proved impossible to reach satisfactory agreed conclusions. For those reasons they are treated only in very general terms and, in a few instances, not even treated at all in the Programme. It should be stressed, however, that a number of concrete approaches to deal with such questions emerged from the exchange of views carried out in the General Assembly which will undoubtedly facilitate the continuation of the study and negotiation of the problems involved in the competent disarmament organs.

IV. Machinery

113. While disarmament, particularly in the nuclear field, has become a necessity for the survival of mankind and for the elimination of the danger of nuclear war, little progress has been made since the end of the Second World War. In addition to the need to exercise political will, the international machinery should be utilized more effectively and also improved to enable implementation of the Programme of Action and help the United Nations to fulfil its role in the field of disarmament. In spite of the best efforts of the international community, adequate results have not been produced with the existing machinery. There is, therefore, an urgent need that existing disarmament machinery be revitalized and forums appropriately constituted for disarmament deliberations and negotiations with a better representative character. For maximum effectiveness, two kinds of bodies are required in the field of disarmament—deliberative and negotiating. All Member States should be represented on the former, whereas the latter, for the sake of convenience, should have a relatively small membership.

114. The United Nations, in accordance with the Charter, has a central role and primary responsibility in the sphere of disarmament. Accordingly, it should play a more active role in this field and, in order to discharge its functions effectively, the United Nations should facilitate and encourage all disarmament measures—unilateral, bilateral, regional or multilateral—and be kept duly informed through the General Assembly, or any other appropriate United Nations channel reaching all Members of the Organization, of all disarmament efforts outside its aegis without prejudice to the progress of negotiations.

115. The General Assembly has been and should remain the main deliberative organ of the United Nations in the field of disarmament and should make every effort to facilitate the implementation of disarmament measures. An item entitled "Review of the implementation of the recommendations and decisions adopted by the General Assembly at its tenth special session" shall be included in the provisional agenda of the thirty-third and subsequent sessions of the General Assembly.

116. Draft multilateral disarmament conventions should be subjected to the normal procedures applicable in the law of treaties. Those submitted to the General Assembly for its commendation should be subject to full review by the Assembly.

117. The First Committee of the General Assembly should deal in the future only with questions of disarmament and related international security questions.

118. The General Assembly establishes, as successor to the Commission originally established by resolution 502 (VI) of 11 January 1952, a Disarmament Commission, composed of all States Members of the United Nations, and decides that:

(*a*) The Disarmament Commission shall be a deliberative body, a subsidiary organ of the General Assembly, the function of which shall be to consider and make recommendations on various problems in the field of disarmament and to follow up the relevant decisions and recommendations of the special session devoted to disarmament. The Disarmament Commission should, *inter alia*, consider the elements of a comprehensive programme for disarmament to be submitted as recommendations to the General Assembly and, through it, to the negotiating body, the Committee on Disarmament;

(*b*) The Disarmament Commission shall function under the rules of procedure relating to the committees of the General Assembly with such modifications as the Commission may deem necessary and shall make every effort to ensure that, in so far as possible, decisions on substantive issues be adopted by consensus;

(*c*) The Disarmament Commission shall report annually to the General Assembly and will submit for consideration by the Assembly at its thirty-third session a report on organizational matters; in 1979, the Disarmament Commission will meet for a period not exceeding four weeks, the dates to be decided at the thirty-third session of the Assembly;

(*d*) The Secretary-General shall furnish such experts, staff and services as are necessary for the effective accomplishment of the Commission's functions.

119. A second special session of the General Assembly devoted to disarmament should be held on a date to be decided by the Assembly at its thirty-third session.

120. The General Assembly is conscious of the work that has been done by the international negotiating body that has been meeting since 14 March 1962 as well as the considerable and urgent work that remains to be accomplished in the field of disarmament. The Assembly is deeply aware of the continuing requirement for a single multilateral disarmament negotiating forum of limited size taking decisions on the basis of consensus. It attaches great importance to the participation of all the nuclear-weapon States in an appropriately constituted negotiating body, the Committee on Disarmament. The Assembly welcomes the agreement reached following appropriate consultations among the Member States during the special session of the General Assembly devoted to disarmament that the Committee on Disarmament will be open to the nuclear-weapon States, and thirty-two to thirty-five other States to be chosen in consultation with the President of the thirty-second session of the Assembly; that the membership of the Committee on Disarmament will be reviewed at regular intervals; that the Committee on Disarmament will be convened in Geneva not later than January 1979 by the country whose name appears first in the alphabetical list of membership; and that the Committee on Disarmament will:

(*a*) Conduct its work by consensus;

(*b*) Adopt its own rules of procedure;

(*c*) Request the Secretary-General of the United Nations, following consultations with the Committee on Disarmament, to appoint the Secretary of the Committee, who shall also act as his personal representative, to assist the Committee and its Chairman in organizing the business and time-tables of the Committee;

(*d*) Rotate the chairmanship of the Committee among all its members on a monthly basis;

(*e*) Adopt its own agenda taking into account the recommendations made to it by the General Assembly and the proposals presented by the members of the Committee;

(*f*) Submit a report to the General Assembly annually, or more frequently as appropriate, and provide its formal and other relevant documents to the States Members of the United Nations on a regular basis;

(*g*) Make arrangements for interested States, not members of the Committee, to submit to the Committee written proposals or working documents on measures of disarmament that are the subject of negotiation in the Committee and to participate in the discussion of the subject-matter of such proposals or working documents;

(*h*) Invite States not members of the Committee, upon their request, to express views in the Committee when the particular concerns of those States are under discussion;

(*i*) Open its plenary meetings to the public unless otherwise decided.

121. Bilateral and regional disarmament negotiations may also play an important role and could facilitate negotiations of multilateral agreements in the field of disarmament.

122. At the earliest appropriate time, a world disarmament conference should be convened with universal participation and with adequate preparation.

123. In order to enable the United Nations to continue to fulfil its role in the field of disarmament and to carry out the additional tasks assigned to it by this special session, the United Nations Centre for Disarmament should be adequately strengthened and its research and information functions accordingly extended. The Centre should also take account fully of the possibilities offered by specialized agencies and other institutions and programmes within the United Nations system with regard to studies and information on disarmament. The Centre should also increase contacts with non-governmental organizations and research institutions in view of the valuable role they play in the field of disarmament. This role could be encouraged also in other ways that may be considered as appropriate.

124. The Secretary-General is requested to set up an advisory board of eminent persons, selected on the basis of their personal expertise and taking into account the principle of equitable geographical representation, to advise him on various aspects of studies to be made under the auspices of the United Nations in the field of disarmament and arms limitation, including a programme of such studies.

* * *

125. The General Assembly notes with satisfaction that the active participation of the Member States in the consideration of the agenda items of the special session and the proposals and suggestions submitted by them and reflected to a considerable extent in the Final Document have made a valuable contribution to the work of the special session and to its positive conclusion. Since a number of those proposals and suggestions,[11] which have become an integral part of the work of the special session of the General Assembly, deserve to be studied further and more thoroughly, taking into

[11] See *Official Records of the General Assembly, Tenth Special Session, Plenary Meetings,* 1st to 25th meetings; *ibid., Tenth Special Session, Supplement No. 1* (A/S-10/1), *Supplement No. 2* (A/S-10/2 and Corr.1), *Supplement No. 2A* (A/S-10/2/Add.1/Rev.1) and *Supplement No. 3* (A/S-10/3 and Corr.1); *ibid., Tenth Special Session, Annexes,* agenda item 7, document A/S-10/10; and *ibid., Tenth Special Session,* Ad Hoc *Committee of the Tenth Special Session,* 1st to 16th meetings, and *ibid.,* Ad Hoc *Committee of the Tenth Special Session, Sessional Fascicle,* corrigendum; A/S-10/5, A/S-10/6 and Corr.1 and Add.1, A/S-10/7 and Corr.1, A/S-10/8 and Add.1 and 2, A/S-10/9, A/S-10/11-14 and A/S-10/17; A/S-10/AC.1/1-8, A/S-10/AC.1/9 and Add.1, A/S-10/AC.1/10 and 11, A/S-10/AC.1/12 and Corr.1, A/S-10/AC.1/13-25, A/S-10/AC.1/26 and Corr.1 and 2, A/S-10/AC.1/27-36, A/S-10/AC.1/37 and Rev.1 and Corr.1 and Rev.1/Add.1, and A/S-10/AC.1/38-40; A/S-10/AC.1/L.1 and Rev.1 and A/S-10/AC.1/L.2-17.

consideration the many relevant comments and observations made in both the general debate in plenary meeting and the deliberations of the *Ad Hoc* Committee of the Tenth Special Session, the Secretary-General is requested to transmit, together with this Final Document, to the appropriate deliberative and negotiating organs dealing with the questions of disarmament all the official records of the special session devoted to disarmament, in accordance with the recommendations which the Assembly may adopt at its thirty-third session. Some of the proposals put forth for the consideration of the special session are listed below:

(*a*) Text of the decision of the Central Committee of the Romanian Communist Party concerning Romania's position on disarmament and, in particular, on nuclear disarmament, adopted on 9 May 1978;[12]

(*b*) Views of the Swiss Government on problems to be discussed at the tenth special session of the General Assembly;[13]

(*c*) Proposals of the Union of Soviet Socialist Republics on practical measures for ending the arms race;[14]

(*d*) Memorandum from France concerning the establishment of an International Satellite Monitoring Agency;[15]

(*e*) Memorandum from France concerning the establishment of an International Institute for Research on Disarmament;[16]

(*f*) Proposal by Sri Lanka for the establishment of a World Disarmament Authority;[17]

(*g*) Working paper submitted by the Federal Republic of Germany entitled "Contribution to the seismological verification of a comprehensive test ban";[18]

(*h*) Working paper submitted by the Federal Republic of Germany entitled "Invitation to attend an international chemical-weapon verification workshop in the Federal Republic of Germany";[19]

(*i*) Working paper submitted by China on disarmament;[20]

(*j*) Working paper submitted by the Federal Republic of Germany concerning zones of confidence-building measures as a first step towards the preparation of a world-wide convention on confidence-building measures;[21]

(*k*) Proposal by Ireland for a study of the possibility of establishing a system of incentives to promote arms control and disarmament;[22]

(*l*) Working paper submitted by Romania concerning a synthesis of the proposals in the field of disarmament;[23]

[12] A/S-10/14.
[13] A/S-10/AC.1/2.
[14] A/S-10/AC.1/4.
[15] A/S-10/AC.1/7.
[16] A/S-10/AC.1/8.
[17] A/S-10/AC.1/9 and Add.1.
[18] A/S-10/AC.1/12 and Corr.1.
[19] A/S-10/AC.1/13.
[20] A/S-10/AC.1/17.
[21] A/S-10/AC.1/20.
[22] A/S-10/AC.1/21.
[23] A/S-10/AC.1/23.

(*m*) Proposal by the United States of America on the establishment of a United Nations Peace-keeping Reserve and on confidence-building measures and stabilizing measures in various regions, including notification of manœuvres, invitation of observers to manœuvres, and United Nations machinery to study and promote such measures;[24]

(*n*) Proposal by Uruguay on the possibility of establishing a polemological agency;[25]

(*o*) Proposal by Belgium, Canada, Denmark, Germany, Federal Republic of, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Sweden, the United Kingdom of Great Britain and Northern Ireland and the United States of America on the strengthening of the security role of the United Nations in the peaceful settlement of disputes and peace-keeping;[26]

(*p*) Memorandum from France concerning the establishment of an International Disarmament Fund for Development;[27]

(*q*) Proposal by Norway entitled "Evaluation of the impact of new weapons on arms control and disarmament efforts";[28]

(*r*) Note verbale transmitting the text, signed in Washington on 22 June 1978 by the Ministers for Foreign Affairs of Argentina, Bolivia, Chile, Colombia, Ecuador, Panama, Peru and Venezuela, reaffirming the principles of the Declaration of Ayacucho with respect to the limitation of conventional weapons;[29]

(*s*) Memorandum from Liberia entitled "Declaration of a new philosophy on disarmament";[30]

(*t*) Statements made by the representatives of China, on 22 June 1978, on the draft Final Document of the tenth special session;[31]

(*u*) Proposal by the President of Cyprus for the total demilitarization and disarmament of the Republic of Cyprus and the implementation of the resolutions of the United Nations;[32]

(*v*) Proposal by Costa Rica on economic and social incentives to halt the arms race;[33]

(*w*) Amendments submitted by China to the draft Final Document of the tenth special session;[34]

(*x*) Proposals by Canada for the implementation of a strategy of suffocation of the nuclear arms race;[35]

(*y*) Draft resolution submitted by Cyprus, Ethiopia and India on the urgent need for cessation of further testing of nuclear weapons;[36]

[24] A/S-10/AC.1/24.
[25] A/S-10/AC.1/25.
[26] A/S-10/AC.1/26 and Corr.1 and 2.
[27] A/S-10/AC.1/28.
[28] A/S-10/AC.1/31.
[29] A/S-10/AC.1/34.
[30] A/S-10/AC.1/35.
[31] A/S-10/AC.1/36.
[32] A/S-10/AC.1/39.
[33] A/S-10/AC.1/40.
[34] A/S-10/AC.1/L.2-4, A/S-10/AC.1/L.7 and 8.
[35] A/S-10/AC.1/AC.1/L.6.
[36] A/S-10/AC.1/L.10.

(*z*) Draft resolution submitted by Ethiopia and India on the non-use of nuclear weapons and prevention of nuclear war;[37]

(*aa*) Proposal by the non-aligned countries on the establishment of a zone of peace in the Mediterranean;[38]

(*bb*) Proposal by the Government of Senegal for a tax on military budgets;[39]

(*cc*) Proposal by Austria for the transmission to Member States of working paper A/AC.187/109 and the ascertainment of their views on the subject of verification;[40]

(*dd*) Proposal by the non-aligned countries for the dismantling of foreign military bases in foreign territories and withdrawal of foreign troops from foreign territories;[41]

(*ee*) Proposal by Mexico for the opening, on a provisional basis, of an *ad hoc* account in the United Nations Development Programme to use for development the funds which may be released as a result of disarmament measures;[42]

(*ff*) Proposal by Italy on the role of the Security Council in the field of disarmament in accordance with Article 26 of the Charter of the United Nations;[43]

(*gg*) Proposal by the Netherlands for a study on the establishment of an international disarmament organization.[44]

126. In adopting this Final Document, the States Members of the United Nations solemnly reaffirm their determination to work for general and complete disarmament and to make further collective efforts aimed at strengthening peace and international security; eliminating the threat of war, particularly nuclear war; implementing practical measures aimed at halting and reversing the arms race; strengthening the procedures for the peaceful settlement of disputes; and reducing military expenditures and utilizing the resources thus released in a manner which will help to promote the well-being of all peoples and to improve the economic conditions of the developing countries.

127. The General Assembly expresses its satisfaction that the proposals submitted to its special session devoted to disarmament and the deliberations thereon have made it possible to reaffirm and define in this Final Document fundamental principles, goals, priorities and procedures for the implementation of the above purposes, either in the Declaration or the Programme of Action or in both. The Assembly also welcomes the important decisions agreed upon regarding the deliberative and negotiating machinery and is confident that these organs will discharge their functions in an effective manner.

128. Finally, it should be borne in mind that the number of States that participated in the general debate, as well as the high level of representation and the depth and scope of that debate, are unprecedented in the history of disarmament efforts. Several Heads of State or Government addressed the General Assembly. In addition, other Heads of State or Government sent messages and expressed their good wishes for the success of the special session of the Assembly. Several high officials of specialized agencies and other institutions and programmes within the United Nations system and spokesmen of

[37] A/S-10/AC.1/L.11.
[38] A/S-10/AC.1/37, para. 72.
[39] *Ibid.*, para. 101.
[40] *Ibid.*, para. 113.
[41] *Ibid.*, para. 126.
[42] *Ibid.*, para. 141.
[43] *Ibid.*, para. 179.
[44] *Ibid.*, para. 186.

twenty-five non-governmental organizations and six research institutes also made valuable contributions to the proceedings of the session. It must be emphasized, moreover, that the special session marks not the end but rather the beginning of a new phase of the efforts of the United Nations in the field of disarmament.

129. The General Assembly is convinced that the discussions of the disarmament problems at the special session and its Final Document will attract the attention of all peoples, further mobilize world public opinion and provide a powerful impetus for the cause of disarmament.

27th plenary meeting
30 June 1978

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The President of the General Assembly subsequently informed the Secretary-General[45] *that the Committee on Disarmament, referred to in paragraph 120 of the above resolution, would be open to the nuclear-weapon States and to the following thirty-five States:* ALGERIA, ARGENTINA, AUSTRALIA, BELGIUM, BRAZIL, BULGARIA, BURMA, CANADA, CUBA, CZECHOSLOVAKIA, EGYPT, ETHIOPIA, GERMAN DEMOCRATIC REPUBLIC, GERMANY, FEDERAL REPUBLIC OF, HUNGARY, INDIA, INDONESIA, IRAN, ITALY, JAPAN, KENYA, MEXICO, MONGOLIA, MOROCCO, NETHERLANDS, NIGERIA, PAKISTAN, PERU, POLAND, ROMANIA, SRI LANKA, SWEDEN, VENEZUELA, YUGOSLAVIA *and* ZAIRE.

[45] A/S-10/24.

Appendix 11B

SIPRI statement to the Special Session of the UN General Assembly Devoted to Disarmament, delivered on 13 June 1978

Excerpt

New approach to disarmament

The arms control treaties now in force have had little or no effect on the military potential of states. The choice of measures adopted has been haphazard. In several cases, the outlawed activities have never even been seriously considered as methods of war. It is now obvious that the method of negotiating small, unrelated steps cannot produce meaningful arms reductions. Insignificant restraints are bound to lag behind the rising levels of armaments and advances in military technology. SIPRI is convinced that a new approach is required.

We have in mind an integrated approach to disarmament, as opposed to piecemeal arms control. Large 'packages' of measures—comprising quantitative reductions and qualitative restrictions to be carried out simultaneously—should be negotiated. This would allow a margin for any trade-offs necessary to take into account the different security needs of states. The wider the range of weapons covered, the greater would be the value of each package. Nuclear weapons and other weapons of mass destruction (particularly chemical warfare agents) must obviously have top priority. But it seems important to us that conventional disarmament should proceed in parallel—not only because conventional armaments account for the bulk of world military expenditures, but also because the very possession of nuclear weapons has been justified by a perceived need to deter aggression started with conventional weapons. Indeed, conventional armed conflict might well escalate into a nuclear war.

Quantitative reductions and qualitative limitations should be accompanied by restrictions on the production, deployment and transfer of weapons. The significance of arms control packages would be further enhanced if they provided for prohibitions of certain specific categories of weapons. Undertakings not to use certain means of warfare might also usefully be included since there is less incentive to develop or maintain weapons with an uncertain future. Cuts in military budgets could be linked to cuts in arms manufacture or other military activities.

The integrated approach places the main emphasis on multilateral negotiations involving all militarily important states, and all participants should be prepared to make certain equitably balanced contributions to disarmament. But the integrated approach is not incompatible with bilateral talks dealing with the US – Soviet arms race or with regional disarmament negotiations, which should be encouraged.

The use of force in international relations should be abolished by eliminating the instruments of war. But complete world-wide disarmament would require an adequate international security system—a workable machinery for the peaceful settlement of disputes and effective peace-keeping arrangements. Our approach of integrated disarmament measures would facilitate the creation of such a security system.

12. Disarmament at the 1978 regular UN General Assembly session

The 33rd session of the UN General Assembly was held shortly after the conclusion of the Special Session on Disarmament. It is understandable, therefore, that only a few new ideas appeared in the debate. However, since the delegations were no longer committed to seeking consensus, as was the case at the Special Session, the tone of the discussion sharpened, and the usual practice of exerting pressure through recommendations adopted by a majority of members, and addressed mainly to the major powers, was resumed. Indeed, a record number of resolutions on disarmament matters (over 40) were passed at the 33rd UN General Assembly. Most of them may be regarded as a direct follow-up to the Final Document of the Special Session, in so far as certain provisions of the Document stated in general terms were transformed into specific decisions. Others deal with matters on which no consensus could be achieved at the Special Session, or which, because of time limitations, were not discussed there in sufficient detail.

I. Disarmament measures

In addition to resolutions which are traditionally adopted by the General Assembly at its annual sessions, and which appeal for a permanent halt to nuclear weapon tests, limitations and reductions of strategic arms, the establishment of nuclear weapon-free zones and zones of peace in different regions, as well as the prohibition of chemical weapons and new weapons of mass destruction, the following important recommendations were made: to declare the use of nuclear weapons to be a violation of the UN Charter and a crime against humanity; to conclude effective international arrangements assuring the non-nuclear weapon states against the use or threat of use of nuclear weapons (the so-called negative security guarantees); to refrain from stationing nuclear weapons on the territories of states where there are no such weapons at present; to refrain from testing nuclear weapons and other nuclear explosive devices, pending the conclusion of a comprehensive test ban treaty; to consider the cessation and prohibition of the production of fissionable material for nuclear weapons and other nuclear explosive devices; to carry out a practical test of an instrument for standardized reporting on the military expenditures of UN member states; and to consider arrangements for confidence-building measures.

The resolution prohibiting the use of nuclear weapons was opposed by the USA, France, the UK and other NATO countries, while the USSR and its allies abstained; it is, therefore, devoid of practical significance. Nevertheless, since the resolution was adopted by a great majority of states (103), it may, to some extent, strengthen the constraints against resort to nuclear arms.

The recommendations (contained in two resolutions) concerning negative security guarantees for non-nuclear weapon states can be regarded as an attempt to convert unilateral declarations on the non-use of nuclear weapons, made by the major powers, into international legally binding measures. The subject is to be considered by the Committee on Disarmament, but an agreement providing for uniform non-use obligations is not in sight. In spite of very few negative votes or abstentions on the resolutions adopted, there are clear differences in attitude among the major powers, as reflected in their official statements (see chapter 11) and the allies of these powers which believe that they are protected by a 'nuclear umbrella', and in the views of the non-aligned countries, some of which fear a nuclear threat while others do not perceive themselves to be under such a threat.

The call, initiated by the Soviet Union, for not stationing nuclear weapons in countries which have hitherto been free of such weapons, received massive support by the non-aligned nations. But it was opposed by NATO members as directed against their interests, among other reasons, because it is intended to lead to the larger objective of the subsequent complete withdrawal of nuclear weapons from the territories of European states. Equally, the request for a moratorium on nuclear weapon testing, endorsed by well over 100 UN members, has little chance of being heeded considering the positions of the testing states.

A cut-off of the production of fissionable material for weapon purposes could be an important arms control measure, if it were properly verified, and if it were to lead to the reduction of stockpiles of these materials. However, in deciding to transmit the relevant resolution to the Committee on Disarmament, the General Assembly did not accord it high priority. The Committee was simply asked to consider the matter "at an appropriate stage" of its pursuit of proposals contained in the Programme of Action adopted by the UN Special Session.

In deciding to explore further the possibility of uniform reporting on military expenditures, the General Assembly reaffirmed its interest in bringing about balanced reductions in these expenditures. To be of some significance, the envisaged test of the reporting instrument would have to cover states from different geographic regions and representing different budgeting and accounting systems. However, the reluctance of the Soviet Union to cooperate may thwart this undertaking.

The resolution regarding confidence-building measures recognizes the need to diminish the danger of armed conflicts resulting from misunderstandings or from misinterpretations of military activities. But the UN General Assembly took a very cautious approach recommending that the views of member states on possible arrangements, taking into account the conditions and requirements of each region, should be transmitted to the next session for further discussion.

II. Studies

In addition to the studies on the relationship between disarmament and development, and that between disarmament and international security, which were already under way, the General Assembly decided that the following subjects should be examined by experts:

(*a*) The state of the existing nuclear arsenals, trends in the technological development of nuclear weapon systems, the effects of their use and the implications for international security as well as for negotiations on disarmament of the doctrines of deterrence and of other theories concerning nuclear weapons, as well as of the continued quantitative increase and qualitative improvement and development of nuclear weapon systems. (Both the USA and the USSR and some of their allies abstained on the relevant resolution.)

(*b*) All aspects of regional disarmament and in particular: the basic conditions governing the regional approach, especially from the standpoint of security requirements; the definition of measures which may lend themselves to a regional approach; and the link between regional measures and the process of general and complete disarmament. (As many as 40 states abstained, including the Soviet Union and certain Warsaw Treaty countries.)

(*c*) Technical, legal and financial implications of establishing an international satellite monitoring agency. (Both the USA and the USSR abstained.)

(*d*) Conditions for the establishment of an international disarmament fund for development; and

(*e*) Ways of establishing, operating and financing an international institute for disarmament research under the auspices of the United Nations.

III. The deliberative and negotiating machinery

The UN General Assembly requested the newly created or revitalized disarmament bodies to take up certain specific issues.

It recommended, in particular, that the Disarmament Commission, composed of all UN members, should, apart from its main task of considering elements of a comprehensive disarmament programme, examine various aspects of the arms race, particularly the nuclear arms race, as well as possible gradual reductions of military budgets and the reallocation of resources thus released for development purposes. The 40-member Committee on Disarmament was asked to undertake, on a priority basis, negotiations for a comprehensive nuclear test ban treaty, and a convention prohibiting the development, production and stockpiling of chemical weapons.

In addition, the General Assembly decided that the UN Conference on prohibitions or restrictions of use of certain inhumane conventional weapons would take place in September 1979, and noted that the conferences to review the Biological Weapons Convention and the Non-Proliferation Treaty would be held in 1980. Another important decision was to convene in 1982 a second special session of the General Assembly devoted to disarmament, and to set up in 1980 a preparatory committee for this session.

IV. Information and education

The General Assembly reiterated that it attaches great importance to the dissemination of information on the ongoing arms races as well as to the propagation of the need for their cessation. It invited both governmental and non-governmental organizations as well as research institutes to participate in these activities, and welcomed the initiative of UNESCO to hold a world congress on disarmament education.

V. Conclusion

It appears from the above review that the 33rd UN General Assembly has made a step forward in consolidating the framework for future disarmament negotiations, and in setting in motion world-wide information and education activities in the field of disarmament. However, no progress was made as regards substantive issues, since a number of important resolutions were not approved by states mainly responsible for their implementation. It was also disappointing that no concrete decision was taken concerning conventional arms limitations (with the exception of the so-called inhumane weapons) or arms transfers. The proceedings and the voting results on major problems showed how tenuous and ambiguous was the consensus on the Final Document of the Special Session on Disarmament.

Appendix 12B summarizes the disarmament resolutions adopted by the 33rd General Assembly and gives the record of voting. For the convenience of the reader, the subject headings are arranged in the order in which they are discussed in chapter 11.

Appendix 12A

UN member states and year of membership

The following list of names of UN member states is provided for convenience in reading the record of votes on the UN resolutions listed in appendix 12B.

Afghanistan, 1946
Albania, 1955
Algeria, 1962
Angola, 1976
Argentina, 1945
Australia, 1945
Austria, 1955
Bahamas, 1973
Bahrain, 1971
Bangladesh, 1974
Barbados, 1966
Belgium, 1945
Benin, 1960
Bhutan, 1971
Bolivia, 1945
Botswana, 1966
Brazil, 1945
Bulgaria, 1955
Burma, 1948
Burundi, 1962
Byelorussia, 1945
Cambodia: see Democratic Kampuchea
Cameroon: see United Republic of Cameroon
Canada, 1945
Cape Verde, 1975
Central African Empire, 1960
Chad, 1960
Chile, 1945
China, 1945
Colombia, 1945
Comoros, 1975
Congo, 1960
Costa Rica, 1945
Cuba, 1945
Cyprus, 1960
Czechoslovakia, 1945
Democratic Kampuchea (Cambodia), 1955
Democratic Yemen,[a] 1967
Denmark, 1945
Djibouti, 1977
Dominica, 1978
Dominican Republic, 1945
Ecuador, 1945
Egypt, 1945
El Salvador, 1945
Equatorial Guinea, 1968
Ethiopia, 1945
Fiji, 1970
Finland, 1955
France, 1945
Gabon, 1960
Gambia, 1965
German Democratic Republic, 1973
Germany, Federal Republic of, 1973
Ghana, 1957
Greece, 1945
Grenada, 1974
Guatemala, 1945
Guinea, 1958
Guinea-Bissau, 1974
Guyana, 1966
Haiti, 1945
Honduras, 1945
Hungary, 1955
Iceland, 1946
India, 1945
Indonesia, 1950
Iran, 1945
Iraq, 1945
Ireland, 1955
Israel, 1949
Italy, 1955
Ivory Coast, 1960
Jamaica, 1962
Japan, 1956
Jordan, 1955
Kampuchea: see Democratic Kampuchea
Kenya, 1963
Kuwait, 1963
Lao People's Democratic Republic, 1955
Lebanon, 1945
Lesotho, 1966
Liberia, 1945

Libya, 1955
Luxembourg, 1945
Madagascar, 1960
Malawi, 1964
Malaysia, 1957
Maldives, 1965
Mali, 1960
Malta, 1964
Mauritania, 1961
Mauritius, 1968
Mexico, 1945
Mongolia, 1961
Morocco, 1956
Mozambique, 1975
Nepal, 1955
Netherlands, 1945
New Zealand, 1945
Nicaragua, 1945
Niger, 1960
Nigeria, 1960
Norway, 1945
Oman, 1971
Pakistan, 1947
Panama, 1945
Papua New Guinea, 1975
Paraguay, 1945
Peru, 1945
Philippines, 1945
Poland, 1945
Portugal, 1955
Qatar, 1971
Romania, 1955
Rwanda, 1962
Samoa, 1976
Sao Tome and Principe, 1975
Saudi Arabia, 1945
Senegal, 1960
Seychelles, 1976
Sierra Leone, 1961
Singapore, 1965
Solomon Islands, 1978
Somalia, 1960
South Africa, 1945
Spain, 1955
Sri Lanka, 1955
Sudan, 1956
Suriname, 1975
Swaziland, 1968
Sweden, 1946
Syria, 1945
Tanzania: see United Republic of Tanzania
Thailand, 1946
Togo, 1960
Trinidad and Tobago, 1962
Tunisia, 1956
Turkey, 1945
Uganda, 1962
Ukraine, 1945
Union of Soviet Socialist Republics, 1945
United Arab Emirates, 1971
United Kingdom, 1945
United Republic of Cameroon, 1960
United Republic of Tanzania, 1961
United States, 1945
Upper Volta, 1960
Uruguay, 1945
Venezuela, 1945
Viet Nam, 1977
Yemen,[a] 1947
Yugoslavia, 1945
Zaire, 1960
Zambia, 1964

[a] The name Democratic Yemen refers to the People's Democratic Republic of Yemen (Southern Yemen). The name Yemen refers to the Yemen Arab Republic (Northern Yemen).

Appendix 12B

UN resolutions on disarmament matters

Note

Only the essential provisions of each resolution are given here. The text has been abridged, but the wording is close to that of the resolution.

The resolutions are grouped according to subject, irrespective of the agenda items under which they were discussed.

Subject, number, date of adoption and contents of the resolution	Voting results
Nuclear disarmament	
33/71 H.I 14 December 1978	
Calls upon the nuclear weapon states involved in the negotiations on the conclusion of a treaty on the prohibition of all nuclear weapon tests to submit to the Committee on Disarmament a draft treaty at the beginning of its 1979 session; calls upon the USSR and the USA to speed up their negotiations on strategic arms limitation (SALT) and to transmit the text of their agreement to the General Assembly; urges all nuclear weapon states to hold consultations, in accordance with paragraph 50 of the Final Document of the Tenth Special Session, regarding an early initiation of urgent negotiations on halting the nuclear arms race and on a progressive and balanced reduction of stockpiles of nuclear weapons and their means of delivery within a comprehensive phased programme with agreed time-frames, leading to their ultimate and complete elimination; and requests the nuclear weapon states to inform the General Assembly, at its thirty-fourth session, of the results of their consultations and eventual negotiations.	*In favour* 129 *Against* 0 *Abstentions* 13: Belgium, Canada, France, Gabon, Federal Republic of Germany, Guatemala, Israel, Italy, Japan, Luxembourg, Netherlands,[a] UK, USA *Absent or not participating in the vote*: Albania, Comoros, Cyprus, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa
33/91 C 16 December 1978	
Deeply regrets that, in spite of all that has been declared, resolved or reiterated over the past decade, it has not yet been possible for the strategic arms limitation talks (SALT) to achieve even the immediate results envisaged in the Final Document of the Tenth Special Session of the General Assembly devoted to disarmament; and trusts that the Soviet and the US governments will fulfil the invitation which the General Assembly addressed to them in paragraph 52 of the Final Document mentioned above, in order	*In favour* 127[b] *Against* 1: Albania *Abstentions* 10: Bulgaria, Byelorussia, Czechoslovakia, Ethiopia, Hungary, Malawi, Mongolia, Poland, Ukraine, USSR

Subject, number, date of adoption and contents of resolution	Voting results
that they may transmit to it in good time the text of the agreement which over the past four years has been pursued in the second series of the SALT talks.	*Absent or not participating in the vote*: China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Lebanon, Lesotho, Liberia, Seychelles, Solomon Islands, South Africa, Upper Volta
33/91 H 16 December 1978 Requests the Committee on Disarmament, at an appropriate stage of its implementation of the proposals set forth in the Programme of Action contained in the Final Document of the Tenth Special Session, to consider urgently the question of an adequately verified cessation and prohibition of the production of fissionable material for nuclear weapons and other nuclear explosive devices and to keep the General Assembly informed of the progress of that consideration.	*In favour* 108 *Against* 10: Bulgaria, Byelorussia, Cuba, Czechoslovakia, German Democratic Republic, Hungary, Mongolia, Poland, Ukraine, USSR *Abstentions* 16: Afghanistan, Algeria, Angola, Argentina, Bhutan, Congo, Egypt, Equatorial Guinea, Ethiopia, France, Guinea, India, Mauritius, Mozambique, Oman, Sao Tome and Principe *Absent or not participating in the vote*: Albania, Brazil, China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Lao People's Democratic Republic, Lebanon, Liberia, Libya,[a] Seychelles, Solomon Islands, South Africa, Upper Volta, Viet Nam
Cessation of nuclear weapon tests	
33/71 C 14 December 1978 Regretting that the Conference of the Committee on Disarmament was not able to commence negotiations on a comprehensive nuclear test ban treaty owing to the non-submission of the joint draft treaty expected from the three nuclear weapon states involved, calls upon all states, in particular all the nuclear weapon states, pending the conclusion of a comprehensive test ban treaty, to refrain from conducting any testing of nuclear weapons and other nuclear explosive devices.	*In favour* 130 *Against* 2: China, France *Abstentions* 8: Belgium, Federal Republic of Germany, Israel, Italy, Luxembourg, Netherlands, UK, USA *Absent or not participating in the vote*: Albania, Argentina, Comoros, Cyprus, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa, Viet Nam

33/60
14 December 1978

Reiterates its grave concern over the fact that nuclear weapon testing has continued unabated against the wishes of the overwhelming majority of member states; reaffirms its conviction that a treaty on the subject of the present resolution is a matter of the highest priority; regrets that a draft treaty has not been concluded during the past year; notes that the three negotiating nuclear weapon states acknowledge the need to bring their negotiations to a speedy and successful conclusion; urges those three states to expedite their negotiations with a view to bringing them to a positive conclusion as a matter of urgency and to use their utmost endeavours to transmit the results to the Committee on Disarmament before the beginning of its 1979 session for full consideration; and requests the Committee on Disarmament to take up immediately the agreed text resulting from the negotiations referred to above with a view to the submission as soon as possible of a draft treaty, which will attract the widest possible adherence, to a resumed thirty-third session of the General Assembly.

In favour 134
Against 1: China
Abstentions 5: Argentina, Cuba, Ethiopia, Fiji, France
Absent or not participating in the vote: Albania, Democratic Kampuchea, Grenada, Liberia, Mauritius,[a] Seychelles, Solomon Islands, South Africa, Sudan, Viet Nam

Prevention of nuclear war

33/71 B
14 December 1978

Declares that: (*a*) the use of nuclear weapons would be a violation of the Charter of the United Nations and a crime against humanity; and (*b*) the use of nuclear weapons should therefore be prohibited, pending nuclear disarmament. Requests all states, particularly nuclear weapon states, to submit to the Secretary-General, before the thirty-fourth session of the General Assembly, proposals concerning the non-use of nuclear weapons, the avoidance of nuclear war and related matters, in order that the question of an international convention or some other agreement on the subject may be discussed at that session.

In favour 103
Against 18: Australia, Belgium, Canada, Denmark, France, Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Turkey, UK, USA
Abstentions 18: Austria, Bulgaria, Byelorussia, Czechoslovakia, El Salvador, Finland, Gabon, German Democratic Republic, Hungary, Israel, Japan, Mongolia, Nicaragua, Poland, Spain, Sweden, Ukraine, USSR
Absent or not participating in the vote: Albania, China, Comoros, Cyprus, Democratic Kampuchea, Grenada, Mauritius,[a] Seychelles, Singapore, Solomon Islands, South Africa

33/72 A
14 December 1978

Considers it necessary to take effective measures for the strengthening of the security of non-nuclear weapon states through appropriate international arrangements; and requests the Committee on Disarmament to consider, to that end, at the earliest possible date, the drafts of an international convention on the

In favour 137
Against 2: Albania, China
Abstentions 4: France, Pakistan, Somalia,

Subject, number, date of adoption and contents of resolution	Voting results
subject, submitted to the General Assembly at its thirty-third session, as well as all proposals and suggestions concerning effective political and legal measures at the international level to assure the non-nuclear weapon states against the use or threat of use of nuclear weapons.	Turkey *Absent or not participating in the vote*: Comoros, Democratic Kampuchea, Ecuador, Grenada, Seychelles, Solomon Islands, South Africa
33/72 B 14 December 1978 Urges that efforts should be made to conclude effective arrangements, as appropriate, to assure the non-nuclear weapon states against the use or threat of use of nuclear weapons, including consideration of an international convention and of alternative ways and means of achieving this objective; takes note of the proposals submitted and views expressed on this subject at its thirty-third session and recommends that the Committee on Disarmament should consider them and submit a progress report to the General Assembly at its thirty-fourth session.	*In favour* 124 *Against* 0 *Abstentions* 14: Afghanistan, Bhutan, Byelorussia, Cuba, Czechoslovakia, German Democratic Republic, Greece, India, Ireland,[a] Israel, Mongolia, Ukraine, USA, USSR *Absent or not participating in the vote*: Albania, Comoros, Congo, Democratic Kampuchea, Grenada, Lao People's Democratic Republic, Malawi, Mozambique, Seychelles, Solomon Islands, South Africa, Viet Nam
Nuclear weapon free zones and zones of peace	
33/58 14 December 1978 Invites the USA to make every effort to ratify as soon as possible Additional Protocol I of the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco); welcomes with satisfaction the declaration made by the President of the French Republic on 25 May 1978 regarding the adherence of his country to Additional Protocol I of the Treaty and invites the government of that country to make every effort to adhere as soon as possible to that Protocol.	Adopted without vote
33/61 14 December 1978 Takes note with satisfaction that Additional Protocol II of the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco) was signed in 1978 by the Soviet Union and that the government of that country has officially announced that it intends to ratify that Protocol in the nearest future.	Adopted without vote

33/63
14 December 1978

Strongly reiterates its call upon all states to consider and respect the continent of Africa, comprising the continental African states, Madagascar and other islands surrounding Africa, as a nuclear weapon free zone; vigorously condemns any attempt by South Africa to introduce in any way whatsoever nuclear weapons into the African continent; demands that South Africa refrain forthwith from conducting any nuclear explosion in the continent of Africa or elsewhere; requests the Security Council to exercise a close watch on South Africa and to take appropriate effective steps to prevent South Africa from developing and acquiring nuclear weapons, thereby endangering international peace and security; condemns any nuclear collaboration by any state, corporation, institution or individual with the racist régime which could frustrate the objective of the Organization of African Unity to keep Africa a nuclear weapon free zone; demands that South Africa submit all its nuclear facilities for inspection by the International Atomic Energy Agency; and appeals to all states to refrain from all cooperation with South Africa in the nuclear field so as not to enable the racist régime to acquire nuclear weapons, and to dissuade corporations, institutions and individuals within their jurisdiction from any cooperation with South Africa in this field.

In favour 136
Against 0
Abstentions 3: France, UK, USA
Absent or not participating in the vote: Albania, Argentina, Democratic Kampuchea, Grenada, Liberia, Mauritius,[a] Paraguay, Seychelles, Solomon Islands, South Africa, Sudan

33/64
14 December 1978

Urges all parties directly concerned to consider taking the practical and urgent steps required for the implementation of the proposal to establish a nuclear weapon free zone in the Middle East in accordance with the relevant resolutions of the General Assembly and, as a means of promoting this objective, invites the countries concerned to adhere to the Treaty on the Non-Proliferation of Nuclear Weapons; invites these countries, pending the establishment of such a zone and during the process of its establishment, to declare solemnly that they will refrain on a reciprocal basis from producing, acquiring or in any other way possessing nuclear weapons and nuclear explosive devices; calls upon these countries to refrain, on a reciprocal basis, from permitting the stationing of nuclear weapons on their territory by any third party, and to agree to place all their nuclear activities under International Atomic Energy Agency safeguards; further invites these countries, pending the establishment of a nuclear weapon free zone in the Middle East and during the process of its establishment, to declare, consistent with paragraph 63 *d* of the Final Document of the Tenth Special Session, their support for establishing such a zone in the region and to deposit these declarations with the Security Council; and again reaffirms its recommendation to the nuclear weapon states to refrain from any action contrary to the spirit and purpose of the present resolution and the objective of establishing in the region of the Middle East a nuclear weapon free zone under an effective system of safeguards, and to extend their cooperation to the states of the region in their efforts to promote these objectives.

In favour 138
Against 0
Abstentions 1: Israel
Absent or not participating in the vote: Albania, Argentina, Chad,[a] Democratic Kampuchea, Grenada, Liberia, Libya, Mauritius,[a] Seychelles, Solomon Islands, South Africa

33/65
14 December 1978

Reaffirms its endorsement, in principle, of the concept of a nuclear weapon free zone in South Asia;

In favour 97[c]

Subject, number, date of adoption and contents of resolution	Voting results
urges once again the states of South Asia and such other neighbouring non-nuclear weapon states as may be interested to continue to make all possible efforts to establish a nuclear weapon free zone in South Asia and to refrain, in the meantime, from any action contrary to this objective; and calls upon those nuclear weapon states which have not done so to respond positively to this proposal and to extend the necessary cooperation in the efforts to establish the above-mentioned zone.	*Against* 2: Bhutan, India *Abstentions* 37: Afghanistan, Algeria, Angola, Argentina, Australia, Austria, Bahamas, Barbados, Botswana, Bulgaria, Burma, Byelorussia, Cuba, Cyprus, Czechoslovakia, Denmark, France, German Democratic Republic, Greece, Hungary, Indonesia, Israel, Italy, Lao People's Democratic Republic, Malawi, Mongolia, Norway, Panama, Poland, Sao Tome and Principe, Singapore, Sweden, Ukraine, USSR, Viet Nam, Yugoslavia, Zambia *Absent or not participating in the vote*: Albania, Congo, Democratic Kampuchea, Equatorial Guinea, Ethiopia, Grenada, Libya, Madagascar, Seychelles, Solomon Islands, South Africa, Swaziland, Syria, United Republic of Tanzania
33/68 14 December 1978 Urges that the talks between the USSR and the USA regarding their military presence in the Indian Ocean be resumed without delay; renews its invitation to the great powers and other major maritime users of the Indian Ocean that have not so far seen their way to cooperating effectively with the *ad hoc* committee on the Indian Ocean to enter with the least possible delay into consultations with the committee regarding the implementation of the Declaration of the Indian Ocean as a zone of peace; decides to convene on 2–13 July 1979 a meeting of the littoral and hinterland states of the Indian Ocean, as the next step towards convening a conference on the Indian Ocean for the implementation of the Declaration of the Indian Ocean as a zone of peace; and requests the meeting of the littoral and hinterland states of the Indian Ocean to submit its report to the thirty-fourth session of the General Assembly.	 *In favour* 130 *Against* 0 *Abstentions* 14: Belgium, Canada, Denmark, France, Federal Republic of Germany, Guatemala, Ireland, Israel, Italy, Luxembourg, Netherlands, Norway, UK, USA *Absent or not participating in the vote*: Albania, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa
33/91 F 16 December 1978 Calls upon all nuclear weapon states to refrain from stationing nuclear weapons on the territories of states where there are no such weapons at present, and calls upon all non-nuclear weapon states which do not have nuclear weapons on their territory to refrain from any steps which would directly or indirectly result in the stationing of such weapons on their territories.	 *In favour* 105 *Against* 18: Australia, Belgium, Canada, Denmark, France, Federal Republic of Germany, Greece, Iceland, Italy, Japan, Luxembourg, Nether-

lands, New Zealand, Norway, Portugal, Turkey, UK, USA
Abstentions 12: Angola, Austria, Brazil, Burma, Cuba, Gabon, Ireland, Israel, Sierra Leone, Singapore, Spain, Sweden
Absent or not participating in the vote: Albania, China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Honduras, Lebanon, Liberia, Libya, Malta, Seychelles, Solomon Islands, South Africa, Upper Volta

Non-proliferation of nuclear weapons

33/57
14 December 1978

Notes that, following appropriate consultations, a preparatory committee has been formed of parties to the Treaty on the Non-Proliferation of Nuclear Weapons serving on the Board of Governors of the International Atomic Energy Agency or represented on the Committee on Disarmament; and requests the Secretary-General to render the necessary assistance and to provide such services as may be required.

In favour 122
Against 1: Albania
Abstentions 16: Algeria, Angola, Argentina, Bhutan, Brazil, Burma, Equatorial Guinea, France, India, Israel, Mozambique, Pakistan, Saudi Arabia, Spain, United Republic of Tanzania, Zambia
Absent or not participating in the vote: Cape Verde, China, Democratic Kampuchea, Grenada, Liberia, Mauritius,[a] Seychelles, Solomon Islands, South Africa, Sudan, Viet Nam

Prohibition of biological and chemical weapons

33/59 B
14 December 1978

Bearing in mind that the Biological Weapons Convention will have been in force for five years on 26 March 1980 and expecting that the review conference called for in the Convention will take place near that date, notes that, after appropriate consultations, a preparatory committee of parties to the Convention is to be arranged and requests the Secretary-General to render the necessary assistance and to provide such services as may be required.

Adopted without vote

33/59 A
14 December 1978

Urges all states to reach early agreement on the effective prohibition of the development, production and

Adopted without vote

Subject, number, date of adoption and contents of resolution	Voting results
stockpiling of all chemical weapons and on their destruction; urges the USSR and the USA to submit their joint initiative to the Committee on Disarmament in order to assist it in achieving early agreement; requests the Committee on Disarmament, as a matter of high priority, to undertake, at the beginning of its 1979 session, negotiations with a view to elaborating an agreement on effective measures for the prohibition of the development, production and stockpiling of all chemical weapons and for their destruction, taking into account all existing proposals and future initiatives; and invites all states that have not yet done so to accede to the Convention on the prohibition of the development, production and stockpiling of bacteriological (biological) and toxin weapons and on their destruction, as well as to accede to or ratify the Protocol for the Prohibition of the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare, and calls again for strict observance by all states of the principles and objectives of those instruments.	
Prohibition of new weapons of mass destruction	
33/66 A 14 December 1978	
Welcomes the active continuation of negotiations relating to the prohibition and limitation of identified weapons of mass destruction; requests the Committee on Disarmament, while taking account of its existing priorities, to pursue its examination of the subject, with any appropriate expert assistance, with a view to reaching agreement on the prevention of the emergence of new weapons of mass destruction based on new scientific principles and achievements and to the speedy preparation of specific agreements on individual types of weapons which may be identified; and urges all states to refrain from actions which might adversely affect the efforts referred to above.	*In favour* 117 *Against* 0 *Abstentions* 24: Afghanistan, Bulgaria, Byelorussia, Cape Verde, Congo, Cuba, Czechoslovakia, Democratic Yemen, Ethiopia, German Democratic Republic, Hungary, Iraq, Jamaica, Kenya, Lao People's Democratic Republic, Malawi, Mongolia, Mozambique, Pakistan, Poland, Uganda, Ukraine, USSR, Viet Nam *Absent or not participating in the vote*: Albania, China, Democratic Kampuchea, Grenada, Mauritius, Seychelles, Solomon Islands, South Africa, Syria
33/66 B 14 December 1978	
Requests the Committee on Disarmament, in the light of its existing priorities, actively to continue negotiations, with the assistance of qualified governmental experts, with a view to agreeing to the text of an agreement on the prohibition of the development and manufacture of new types of weapons of mass destruction and new systems of such weapons, and to expedite the preparation of specific agreements on	*In favour* 118 *Against* 0 *Abstentions* 24: Australia, Austria, Belgium, Canada, Denmark, France, Federal Republic of

particular types of such weapons; and urges all states to refrain from any action which could adversely affect the talks aimed at working out an agreement or agreements to prevent the emergence of new types of weapons of mass destruction and new systems of such weapons.

Germany, Greece, Guatemala, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Turkey, UK, USA
Absent or not participating in the vote: Albania, China, Democratic Kampuchea, Grenada, Iraq, Seychelles, Solomon Islands, South Africa

Prohibition of inhumane conventional weapons

33/70
14 December 1978

Takes note of the report of the Preparatory Conference for the UN Conference on prohibitions or restrictions of use of certain conventional weapons which may be deemed to be excessively injurious or to have indiscriminate effects, on its first session and on the progress made with regard to organizational aspects; notes that a number of proposals on the substantive work of the UN Conference were introduced and views exchanged on them; reaffirms its belief that the UN Conference should strive to reach agreement on specific instruments in the field of certain conventional weapons; endorses the decision of the Preparatory Conference to hold another session from 19 March to 12 April 1979; endorses the recommendation that the UN Conference should be held at Geneva from 10 to 28 September 1979; and invites states to participate actively in the further work of the Preparatory Conference and in the UN Conference itself and to be represented, in so far as possible, by the required legal, military and medical expertise.

Adopted without vote

Reduction of military expenditures

33/67
14 December 1978

Requests the Secretary-General, with the assistance of an *ad hoc* panel of experienced practitioners in the field of military budgeting: (*a*) to carry out a practical test of the proposed instrument for standardized reporting on military expenditure with the voluntary cooperation of states from different regions and representing different budgeting and accounting systems; (*b*) to assess the results of the practical test; and (*c*) to develop recommendations for further refinement and implementation of the reporting instrument. Requests the Secretary-General to report to the General Assembly at its thirty-fifth session on the implementation of this resolution.

In favour 121
Against 0
Abstentions 18: Afghanistan, Bulgaria, Byelorussia, Congo, Cuba, Czechoslovakia, El Salvador, Equatorial Guinea, Ethiopia, German Democratic Republic, Hungary, Iraq, Mongolia, Mozambique, Poland, Ukraine, USSR, Zambia
Absent or not participating in the vote: Albania, Benin, China, Democratic Kampuchea, Grenada, Lao People's Democratic Republic, Seychelles, Solomon Islands, South Africa, Syria, Viet Nam

Subject, number, date of adoption and contents of resolution	Voting results
Confidence-building measures	
33/91 B 16 December 1978	
Recognizing the need and urgency of first steps to diminish the danger of armed conflicts resulting from misunderstandings or from misinterpretations of military activities, recommends all states to consider on a regional basis arrangements for specific confidence-building measures, taking into account the specific conditions and requirements of each region, and invites all states to inform the Secretary-General of their views and experiences of those confidence-building measures they consider appropriate and feasible.	*In favour* 132 *Against* 0 *Abstentions* 2: Kuwait, United Arab Emirates *Absent or not participating in the vote*: Albania, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Iraq, Jordan, Lebanon, Liberia, Libya, Mauritius,[a] Seychelles, Solomon Islands, South Africa, Syria, Upper Volta
Embargo on arms deliveries	
33/71 A 14 December 1978	
Requests the Security Council to call upon all states: (*a*) to refrain from any supply of arms, ammunition, military equipment or vehicles, or spare parts therefor, to Israel, without any exception; (*b*) to ensure that such supplies do not reach Israel through other parties; and (*c*) to end all transfer of nuclear equipment or fissionable material or technology to Israel. Further requests the Security Council to establish a machinery for supervising the implementation of the measures referred to above.	*In favour* 72 *Against* 30: Australia, Austria, Bahamas, Belgium, Bolivia, Canada, Denmark, Dominican Republic, El Salvador, Finland, France, Federal Republic of Germany, Guatemala, Haiti, Honduras, Iceland, Ireland, Israel, Italy, Luxembourg, Netherlands, New Zealand, Nicaragua, Norway, Paraguay, Suriname, Sweden, UK, USA, Uruguay *Abstentions* 37: Argentina, Barbados, Burma, Central African Empire, Chile, Colombia, Costa Rica, Ecuador, Ethiopia, Fiji, Ghana, Greece, Ivory Coast, Jamaica, Japan, Kenya, Lesotho, Liberia, Malawi, Mauritius, Mexico, Nepal, Panama, Papua New Guinea, Peru, Philippines, Portugal, Rwanda, Samoa, Sierra Leone, Singapore, Spain, Swaziland, Thailand, Trinidad and Tobago, Upper Volta, Venezuela *Absent or not participating in the vote*: Brazil, Cyprus, Democratic Kampuchea, Gabon, Grenada, Iran, Seychelles, Solomon Islands, South Africa, Turkey, Zaire

Studies

33/62
14 December 1978

Expresses its satisfaction that the group of governmental experts on the relationship between disarmament and development has been convened by the Secretary-General to commence its study and looks forward to receiving an interim report on the study at its thirty-fourth session; takes note of the preparations for the strategy for the third United Nations development decade and stresses the need to continue to promote the link between the strategy for disarmament and the strategy for development.

Adopted without vote

33/71 I
14 December 1978

Requests the Secretary-General to transmit to the group of governmental experts on the relationship between disarmament and development, for its consideration, the proposal to establish an international disarmament fund for development which was submitted to the General Assembly at its Tenth Special Session.

Adopted without vote

33/71 M
14 December 1978

Takes note of the organizational report of the Group of governmental experts on the relationship between disarmament and development; appeals to all governments seriously to consider giving, as a supplement to the financial resources allocated for the study in the regular budget of the United Nations, voluntary contributions to the Disarmament Project Fund or to finance, on a voluntary basis, and in domestic currency, where appropriate, national research projects, in order to ensure the total resources necessary to carry out the study; and appeals to governments to make available data and information relevant to a meaningful completion of the study.

Adopted without vote

33/91 I
16 December 1978

Considers that the maintenance of international security through the United Nations in accordance with the provisions of the Charter is an essential objective of the Disarmament Decade, and requests the Secretary-General to expedite action for the continuation of the study of the relationship between disarmament and international security, with a view to submitting a progress report to the General Assembly at its thirty-fourth session and the final report to the Assembly at its thirty-fifth session.

Adopted without vote

33/91 D
16 December 1978

Requests the Secretary-General, with the assistance of qualified experts, to carry out a comprehensive study providing factual information on present nuclear arsenals, on trends in the technological develop-

In favour 117
Against 0

Subject, number, date of adoption and contents of resolution	Voting results
ment of nuclear weapon systems, on the effects of their use and the implications for international security as well as for disarmament negotiations of: (*a*) the doctrines of deterrence and other theories concerning nuclear weapons; and (*b*) the continued quantitative increase and qualitative improvement and development of nuclear weapon systems. Recommends that the study should be based on open material and such further information that member states may wish to make available for the purpose of the study and requests the Secretary-General to submit the final report to the General Assembly at its thirty-fifth session.	*Abstentions* 21: Angola, Belgium, Bulgaria, Byelorussia, Cuba, Czechoslovakia, France, German Democratic Republic, Federal Republic of Germany, Greece, Hungary, Israel, Italy, Luxembourg, Mongolia, Netherlands, Poland, Ukraine, UK, USA, USSR *Absent or not participating in the vote*: Albania, China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Lebanon, Liberia, Seychelles, Solomon Islands, South Africa, Upper Volta
33/71 J 14 December 1978 Requests the Secretary-General to obtain, not later than 31 March 1979, the views of member states on the proposal to establish an international satellite monitoring agency, as explained in a memorandum dated 30 May 1978 submitted to the General Assembly at its Tenth Special Session; requests the Secretary-General to undertake, as from 1 May 1979, with the assistance of a group of qualified governmental experts, a study on the technical, legal and financial implications of establishing an international satellite monitoring agency; and requests the Secretary-General to report to the General Assembly at its thirty-fourth session on the replies received from governments and the preliminary conclusions of the group of experts.	*In favour* 121 *Against* 0 *Abstentions* 18: Afghanistan, Angola, Bulgaria, Byelorussia, Cuba, Czechoslovakia, Democratic Yemen, Ethiopia, German Democratic Republic, Hungary, Mongolia, Mozambique, Poland, Sao Tome and Principe, Sudan, Ukraine, USA, USSR *Absent or not participating in the vote*: Albania, Comoros, Congo, Democratic Kampuchea, Grenada, Lao People's Democratic Republic, Malawi, Seychelles, Solomon Islands, South Africa, Viet Nam
33/91 E 16 December 1978 Decides to undertake a systematic study of all the aspects of regional disarmament. The study shall cover, *inter alia*, the following subjects: (*a*) basic conditions governing the regional approach, particularly from the standpoint of security requirements; (*b*) definition of measures which, on the initiative of the states concerned, may lend themselves to a regional approach; and (*c*) link between regional measures and the process of general and complete disarmament. Requests the Secretary-General to carry out the study with the assistance of a group of qualified governmental experts, appointed by him on a balanced geographical basis, and to submit it to the General Assembly at its thirty-fifth session.	*In favour* 93 *Against* 0 *Abstentions* 40: Afghanistan, Algeria, Angola, Bahrain, Barbados, Bhutan, Brazil, Bulgaria, Burma, Byelorussia, Congo, Cuba, Czechoslovakia, Democratic Yemen, Djibouti, Egypt, Ethiopia, German Democratic Republic, Hungary, India, Indonesia, Iraq, Jamaica, Jordan, Kuwait,

Malaysia, Mauritius, Mongolia, Mozambique, Oman, Sao Tome and Principe, Somalia, Sri Lanka, Sudan, Syrian Arab Republic, Ukraine, United Arab Emirates, USSR, Yemen, Yugoslavia

Absent or not participating in the vote: Albania, Cape Verde, China, Costa Rica, Democratic Kampuchea, Equatorial Guinea, Gambia, Grenada, Lao People's Democratic Republic, Lebanon, Liberia, Libya, Seychelles, Solomon Islands, South Africa, Upper Volta, Viet Nam

33/71 K
14 December 1978

Requests the Secretary-General to report to the General Assembly at its thirty-fourth session on possible ways of establishing, operating and financing an international institute for disarmament research under UN auspices; and requests the Secretary-General to seek in this regard, *inter alia*, the advice of the Advisory Board on disarmament studies, established in implementation of paragraph 124 of the Final Document of the Tenth Special Session of the General Assembly, in view of the competence to be assigned to that body in respect of a programme of studies on disarmament.

Adopted without vote

33/71 N
14 December 1978

Considers it necessary that all the new ideas, proposals, thinking and strategies set forth in the broad range of general debates preceding and following the adoption of the Final Document of the Tenth Special Session be formulated in a single, comprehensive and coordinated system, in a new philosophy on disarmament, and in a message that can effectively reach the minds of men in a mobilization of world public opinion in support of the United Nations goal for the halting of the present arms race and eventually for general and complete disarmament centred on a new order of national and international security; and requests the Secretary-General, with the assistance of the Advisory Board on disarmament studies, to study ways and means whereby the above objectives can be accomplished and to report to the General Assembly at its thirty-fourth session.

Adopted without vote

Machinery for deliberation and negotiation

33/71 F
14 December 1978

Takes note with satisfaction of the measures adopted, or about to be adopted, to revitalize the multilateral disarmament machinery available to the United Nations; expresses the hope that all nuclear weapon states will participate in the Committee on Disarmament; notes with satisfaction that progress has been, or is being, made in the adoption of measures aimed at promoting studies, information, teaching and training on disarmament; regrets, however, that with regard to the Programme of Action of the Final Document of the Special Session on Disarmament it has not yet been possible to achieve any of the priority agreements mentioned therein, in particular the agreement for a comprehensive test ban and the agreement pursued in the second series of the strategic arms limitation talks; urgently calls upon all

Adopted without vote

Subject, number, date of adoption and contents of resolution	Voting results
states, in particular the nuclear weapon states, to make every effort to proceed along the road of binding and effective international agreements in the field of disarmament in order to translate into practical terms the measures called for in the Programme of Action; and invites all states to communicate to the Secretary-General all those measures adopted outside the aegis of the United Nations regarding the implementation of the recommendations and decisions of the Tenth Special Session, whether unilateral, bilateral, regional or multilateral.	
33/71 L 14 December 1978	
Requests the Secretary-General to transmit to the organs dealing with the question of disarmament all the proposals and suggestions listed in paragraph 125 of the Final Document of the Tenth Special Session, together with all the official records of the Special Session, as well as information and comments made by member states at the thirty-third session of the Assembly on those proposals and suggestions, except those covered by separate resolutions; and requests the Disarmament Commission and the Committee on Disarmament to report on the state of the consideration of those proposals and suggestions to the General Assembly at its thirty-fifth session.	Adopted without vote
33/71 H.II 14 December 1978	
Recommends the inclusion in the agenda of the forthcoming session of the Disarmament Commission, apart from the consideration of elements of a comprehensive programme on disarmament as a priority item, the following questions related to disarmament: (*a*) consideration of various aspects of the arms race, particularly the nuclear arms race and nuclear disarmament, in order to expedite negotiations aimed at effective elimination of the danger of nuclear war; and (*b*) harmonization of views on concrete steps to be undertaken by states regarding a gradual, agreed reduction of military budgets and reallocation of resources now being used for military purposes to economic and social development, particularly for the benefit of the developing countries.	*In favour* 129 *Against* 0 *Abstentions* 13: Belgium, Canada, France, Gabon, Federal Republic of Germany, Guatemala, Israel, Italy, Japan, Luxembourg, Netherlands,[a] UK, USA *Absent or not participating in the vote*: Albania, Comoros, Cyprus, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa
33/91 A 16 December 1978	
Requests the Disarmament Commission to submit to the General Assembly a report on its work, including any recommendations and observations it may deem appropriate, and requests the Secretary-General to invite member states to communicate to him, by 31 March 1979, their views and suggestions on the comprehensive programme of disarmament for transmission to the Disarmament Commission.	Adopted without vote

33/71 H.IV
14 December 1978

Requests the Committee on Disarmament to undertake a priority basis, at its first session, negotiations concerning: (*a*) a treaty on the complete prohibition of nuclear weapon tests; and (*b*) a treaty or convention on the complete and effective prohibition of the development, production and stockpiling of all types of chemical weapons and on their destruction. Requests the Committee to submit reports to the General Assembly annually or more frequently, as appropriate, and provide its formal and other relevant documents to member states on a regular basis.

In favour 129
Against 0
Abstentions 13: Belgium, Canada, France, Gabon, Federal Republic of Germany, Guatemala, Israel, Italy, Japan, Luxembourg, Netherlands,[a] UK, USA
Absent or not participating in the vote: Albania, Comoros, Cyprus, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa

33/91 G
16 December 1978

Recommends that the first review of the membership of the Committee on Disarmament should be completed, following appropriate consultations among member states, during the next special session of the General Assembly devoted to disarmament. Requests the Committee to consider the modalities of the review of its membership and to report on this subject to the General Assembly during its thirty-fifth session.

In favour 126
Against 9: Bulgaria, Byelorussia, Czechoslovakia, German Democratic Republic, Hungary, Mongolia, Poland, Ukraine, USSR
Abstentions 1: Mexico
Absent or not participating in the vote: Albania, China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Lao People's Democratic Republic, Lebanon, Liberia, Seychelles, Solomon Islands, South Africa, Upper Volta, Viet Nam

33/69
14 December 1978

Renews the mandate of the *ad hoc* committee on the world disarmament conference, and requests it to maintain close contact with the representatives of the states possessing nuclear weapons in order to remain informed of their attitudes as well as with all other states, and to consider any relevant comments and observations which might be made to the Committee, having especially in mind paragraph 122 of the Final Document of the Tenth Special Session.

Adopted without vote

33/71 H.III
14 December 1978

Decides to convene a second special session of the General Assembly devoted to disarmament in 1982 at UN Headquarters in New York; and also decides to set up, at its thirty-fifth session, a preparatory committee for the special session.

In favour 129
Against 0
Abstentions 13: Belgium, Canada, France, Gabon, Federal Republic of Germany, Guatemala,

Subject, number, date of adoption and contents of resolution	Voting results
	Israel, Italy, Japan, Luxembourg, Netherlands,[a] UK, USA *Absent or not participating in the vote*: Albania, Comoros, Cyprus, Democratic Kampuchea, Grenada, Seychelles, Solomon Islands, South Africa
Information, education and training	
33/71 D 14 December 1978	
Invites all states to carry out, through dissemination of information and organization of symposia, meetings, conferences and other national and international forums, effective measures to expose the danger of the arms race, propagate the need for its cessation and increase public understanding of the urgent tasks in the field of disarmament and in particular of the provisions of the Final Document of the Tenth Special Session of the General Assembly. Requests the Secretary-General to prepare a model programme which may assist states that so desire in developing their local programmes for an annual Disarmament Week (starting on 24 October) and invites governmental as well as non-governmental organizations to undertake annual activities to promote the objectives of Disarmament Week.	Adopted without vote
33/71 E 14 December 1978	
Requests the Secretary-General to make adequate arrangements in order that the programme of fellowships on disarmament may be commenced during the first half of 1979.	Adopted without vote
33/71 G 14 December 1978	
Urges member states, the specialized agencies and the International Atomic Energy Agency, as well as non-governmental organizations and concerned research institutes, to promote education and information programmes relating to the arms race and disarmament; requests member states to report to the General Assembly, through the Secretary-General, on their activities in the field of dissemination of information on the arms race and disarmament; welcomes the initiative of UNESCO in planning to hold a world congress on disarmament education and, in that connection, invites the Director-General of that organization to report to the General Assembly at its thirty-fourth session on the preparations for that event; requests the UN Centre for Disarmament, in preparing the *United Nations Yearbook on Disarmament* and the disarmament periodical, to take account of the recommendations of the General Assembly	Adopted without vote

regarding the form and content of such publications; further requests the Centre for Disarmament to increase contacts with non-governmental organizations and research institutions, in accordance with paragraph 123 of the Final Document of the Tenth Special Session and, after appropriate consultations, to report to the General Assembly at its thirty-fourth session on other ways of encouraging the role of such organizations and institutions in the field of disarmament; requests the Secretary-General to include in any studies on arms limitation and disarmament prepared under the auspices of the United Nations a summary of those studies, drafted in easily understood language, to facilitate their dissemination among the general public; and requests the Secretary-General to explore the possibilities of coordinating the public information activities relating to disarmament of all specialized agencies and the International Atomic Energy Agency.

33/422
16 December 1978

Requests the Secretary-General to proceed with the production of a United Nations film on wars and their consequences.

In favour 108
Against 0
Abstentions 23: Afghanistan, Australia, Bulgaria, Byelorussia, Canada, Cuba, Czechoslovakia, Denmark, Ethiopia, German Democratic Republic, Hungary, Iceland, Italy, Ivory Coast, Mongolia, New Zealand, Norway, Papua New Guinea, Sweden, UK, Ukraine, USA, USSR
Absent or not participating in the vote: Albania, Cape Verde, China, Costa Rica, Democratic Kampuchea, Gambia, Grenada, Guinea Bissau, Israel, Lebanon, Liberia, Nicaragua, Poland, Seychelles, Solomon Islands, South Africa, Turkey, Upper Volta, Viet Nam

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[a] Later advised the Secretariat it had intended to vote in favour.
[b] German Democratic Republic later advised the Secretariat it had intended to abstain.
[c] Mauritius later advised the Secretariat it had intended to abstain.

13. The implementation of multilateral arms control agreements

The eight major multilateral arms control treaties and conventions in force on 31 December 1978 were concluded with the following objectives:

(*a*) to prevent militarization or military nuclearization of certain areas or environments (Antarctica, Latin America, outer space and the sea-bed);

(*b*) to restrict nuclear weapon tests;

(*c*) to prevent the spread of nuclear weapons;

(*d*) to prohibit the production and eliminate the stockpiles of biological weapons; and

(*e*) to prevent the use of environmental forces for military ends.

Section I of this chapter summarizes the essential provisions of the agreements, while Section II gives detailed information on the signatures, ratifications, accessions or successions.

I. Summary of the essential provisions of the agreements

Antarctic Treaty

Signed at Washington on 1 December 1959.
Entered into force on 23 June 1961.
Depositary: US government.

Declares the Antarctic an area to be used exclusively for peaceful purposes. Prohibits any measure of a military nature in the Antarctic, such as the establishment of military bases and fortifications, and the carrying out of military manoeuvres or the testing of any type of weapon. Bans any nuclear explosion as well as the disposal of radioactive waste material in Antarctica, subject to possible future international agreements on these subjects.

Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water (Partial Test Ban Treaty—PTBT)

Signed at Moscow on 5 August 1963.
Entered into force on 10 October 1963.
Depositaries: UK, US and Soviet governments.

Prohibits the carrying out of any nuclear weapon test explosion, or any other nuclear explosion: (*a*) in the atmosphere, beyond its limits, including outer space, or under water, including territorial waters or high seas; or (*b*) in any other environment if such explosion causes radioactive debris to be present outside the territorial limits of the state under whose jurisdiction or control the explosion is conducted.

Treaty on principles governing the activities of states in the exploration and use of outer space, including the moon and other celestial bodies (Outer Space Treaty)

Signed at London, Moscow and Washington on 27 January 1978.
Entered into force on 10 October 1967.
Depositaries: UK, US and Soviet governments.

Prohibits the placing in orbit around the Earth of any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, the installation of such weapons on celestial bodies, or the stationing of them in outer space in any other manner. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies are also forbidden.

Treaty for the prohibition of nuclear weapons in Latin America (Treaty of Tlatelolco)

Signed at Mexico, Federal District, on 14 February 1967.

The Treaty enters into force for each state that has ratified it when the requirements specified in the Treaty have been met—that is, that all states in the region which were in existence when the Treaty was opened for signature deposit the instruments of ratification; that Additional Protocols I and II be signed and ratified by those states to which they apply (see below); and that agreements on safeguards be concluded with the IAEA. The signatory states have the right to waive, wholly or in part, those requirements.

The Treaty came into force on 22 April 1968 as between Mexico and El Salvador, on behalf of which instruments of ratification, with annexed declarations wholly waiving the above requirements, were deposited on 20 September 1967 and 22 April 1968, respectively.

Depositary: Mexican government.

Prohibits the testing, use, manufacture, production or acquisition by any means, as well as the receipt, storage, installation, deployment and any form of possession of any nuclear weapons by Latin American countries.

The parties should conclude agreements with the International Atomic Energy Agency (IAEA) for the application of safeguards to their nuclear activities.

Additional Protocols

The Additional Protocols enter into force for the states that have ratified them on the date of the deposit of their instruments of ratification.

Depositary: Mexican government.

Under *Additional Protocol I*, annexed to the Treaty, the extra-continental or continental states which, *de jure* or *de facto*, are internationally responsible for territories lying within the limits of the geographical zone established by the Treaty (France, the Netherlands, the UK and the USA), undertake to apply the statute of military denuclearization, as defined in the Treaty, to such territories.

Under *Additional Protocol II,* annexed to the Treaty, the nuclear weapon states undertake to respect the statute of military denuclearization of Latin America, as defined in the Treaty, and not to contribute to acts involving a violation of the Treaty, nor to use or threaten to use nuclear weapons against the parties to the Treaty.

Treaty on the non-proliferation of nuclear weapons (Non-Proliferation Treaty —NPT)

Signed at London, Moscow and Washington on 1 July 1968.
Entered into force on 5 March 1970.
Depositaries: UK, US and Soviet governments.

Prohibits the transfer by nuclear weapon states to any recipient whatsoever of nuclear weapons or other nuclear explosive devices or of control over them, as well as the assistance, encouragement or inducement of any non-nuclear weapon state to manufacture or otherwise acquire such weapons or devices. Prohibits the receipt by non-nuclear weapon states from any transferor whatsoever, as well as the manufacture or other acquisition by those states, of nuclear weapons or other nuclear explosive devices.

Non-nuclear weapon states undertake to conclude safeguards agreements with the International Atomic Energy Agency (IAEA) with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices.

The parties undertake to facilitate the exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy and to ensure that potential benefits from peaceful applications of nuclear explosions will be made available to non-nuclear weapon parties to the Treaty. They also undertake to pursue negotiations on effective measures relating to cessation of the nuclear arms race and to nuclear disarmament, and on a treaty on general and complete disarmament.

Treaty on the prohibition of the emplacement of nuclear weapons and other weapons of mass destruction on the sea-bed and the ocean floor and in the subsoil thereof (Sea-Bed Treaty)

Signed at London, Moscow and Washington on 11 February 1971.
Entered into force on 18 May 1972.
Depositaries UK, US and Soviet governments.

Prohibits emplanting or emplacing on the sea-bed and the ocean floor and in the subsoil thereof beyond the outer limit of a sea-bed zone (coterminous with the 12-mile outer limit of the zone referred to in the 1958 Geneva Convention on the Territorial Sea and the Contiguous Zone) any nuclear weapons or any other types of weapons of mass destruction as well as structures, launching installations or any other facilities specifically designed for storing, testing or using such weapons.

Convention on the prohibition of the development, production and stockpiling of bacteriological (biological) and toxin weapons and on their destruction (BW Convention)

Signed at London, Moscow and Washington on 10 April 1972.
Entered into force on 26 March 1975.
Depositaries: UK, US and Soviet governments.

Prohibits the development, production, stockpiling or acquisition by other means or retention of microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes, as well as weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict. The destruction of the agents, toxins, weapons, equipment and means of delivery in the possession of the parties, or their diversion to peaceful purposes, should be effected not later than nine months after the entry into force of the Convention.

Convention on the prohibition of military or any other hostile use of environmental modification techniques (ENMOD Convention)

Signed at Geneva on 18 May 1977.
Entered into force on 5 October 1978.
Depositary: UN Secretary-General.

Prohibits military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to states party to the Convention. The term 'environmental modification techniques' refers to any technique for changing—through the deliberate manipulation of natural processes—the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space.

II. Signatures, ratifications, accessions and successions to multilateral arms control treaties, as of 31 December 1978

Number of parties

Antarctic Treaty	19	
Partial Test Ban Treaty	109	
Outer Space Treaty	78	
Treaty of Tlatelolco	22	
Additional Protocol I	2	
Additional Protocol II	5	
Non-Proliferation Treaty	105	
NPT safeguards agreements	60	non-nuclear weapon states
Sea-Bed Treaty	66	
BW Convention	80	
ENMOD Convention	21	

Note

1. Key to abbreviations used in the table:
   S: signature
   R: deposit of instruments of ratification, accession or succession

Place of signature and/or deposit of the instrument of ratification, accession or succession:
   L: London
   M: Moscow
   W: Washington

Under the Antarctic Treaty, the only depositary is the US government; under the Treaty of Tlatelolco, the Mexican government; and under the ENMOD Convention, the UN Secretary-General.

For the Treaty of Tlatelolco:
   P.I: Additional Protocol I
   P.II: Additional Protocol II

For the NPT and the Treaty of Tlatelolco:
   S.A.: Safeguards agreement in force with the International Atomic Energy Agency (IAEA)

2. The footnotes are listed at the end of the table and are grouped separately under the heading for each agreement.

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Afghanistan		S: 8 Aug 1963 LW 9 Aug 1963 M R: 12 Mar 1964 L 13 Mar 1964 W 23 Mar 1964 M	S: 27 Jan 1967 W 30 Jan 1967 M	
Algeria		S: 14 Aug 1963 LW 19 Aug 1963 M		
Argentina	S: 1 Dec 1959 R: 23 Jun 1961	S: 8 Aug 1963 W 9 Aug 1963 LM	S: 27 Jan 1967 W 18 Apr 1967 M R: 26 Mar 1969 MW	S:[1] 27 Sep 1967
Australia	S: 1 Dec 1959 R: 23 Jun 1961	S: 8 Aug 1963 LMW R: 12 Nov 1963 LMW	S: 27 Jan 1967 W R: 10 Oct 1967 LMW	
Austria		S: 11 Sep 1963 MW 12 Sep 1963 L R: 17 Jul 1964 LMW	S: 20 Feb 1967 LMW R: 26 Feb 1968 LMW	
Bahamas		R:[1] 16 Jul 1976 LM 13 Aug 1976 W	R:[1] 11 Aug 1976 L 13 Aug 1976 W 30 Aug 1976 M	S: 29 Nov 1976 R:[2] 26 Apr 1977
Barbados			R: 12 Sep 1968 W	S: 18 Oct 1968 R:[2] 25 Apr 1969
Belgium	S: 1 Dec 1959 R: 26 Jul 1960	S: 8 Aug 1963 LMW R: 1 Mar 1966 LMW	S: 27 Jan 1967 LM 2 Feb 1967 W R: 30 Mar 1973 W 31 Mar 1973 LM	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 LMW R: 4 Feb 1970 W 5 Feb 1970 M 5 Mar 1970 L S.A.: 20 Feb 1978	S: 11 Feb 1971 LMW R: 22 Apr 1971 M 23 Apr 1971 L 21 May 1971 W	S: 10 Apr 1972 LMW R: 26 Mar 1975 L	
	S:[1] 3 Sep 1971 LMW	S: 1 Aug 1972 M 3 Aug 1972 L 7 Aug 1972 W	
S:[1] 27 Feb 1970 LMW R: 23 Jan 1973 LMW S.A.: 10 Jul 1974	S: 11 Feb 1971 LMW R: 23 Jan 1973 LMW	S: 10 Apr 1972 LMW R: 5 Oct 1977 LMW	S: 31 May 1978
S: 1 Jul 1968 LMW R: 27 Jun 1969 LMW S.A.: 23 Jul 1972	S: 11 Feb 1971 LMW R: 10 Aug 1972 LMW	S: 10 Apr 1972 LMW R:[1] 10 Aug 1973 LMW	
R:[2] 11 Aug 1976 L 13 Aug 1976 W 30 Aug 1976 M			
S: 1 Jul 1968 W		S: 16 Feb 1973 W R: 16 Feb 1973 W	
S: 20 Aug 1968 LMW R: 2 May 1975 LW 4 May 1975 M S.A.: 21 Feb 1977	S: 11 Feb 1971 LMW R: 20 Nov 1972 LMW	S: 10 Apr 1972 LMW	S: 18 May 1977

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Benin		S:[2] 27 Aug 1963 W 3 Sep 1963 L 9 Oct 1963 M R: 15 Dec 1964 W 23 Dec 1964 M 22 Apr 1965 L		
Bhutan		R: 8 Jun 1978 W		
Bolivia		S: 8 Aug 1963 W 21 Aug 1963 L 20 Sep 1963 M R: 4 Aug 1965 MW 25 Jan 1966 L	S: 27 Jan 1967 W	S: 14 Feb 1967 R:[2] 18 Feb 1969
Botswana		R:[1] 5 Jan 1968 M 14 Feb 1968 L 4 Mar 1968 W	S: 27 Jan 1967 W	
Brazil	R: 16 May 1975	S: 8 Aug 1963 LW 9 Aug 1963 M R: 15 Dec 1964 M 15 Jan 1965 W 4 Mar 1965 L	S: 30 Jan 1967 M 2 Feb 1967 LW R:[2] 5 Mar 1969 LMW	S:[3] 9 May 1967 R:[4] 29 Jan 1968
Bulgaria		S: 8 Aug 1963 LMW R: 13 Nov 1963 W 21 Nov 1963 M 2 Dec 1963 L	S: 27 Jan 1967 LMW R: 28 Mar 1967 M 11 Apr 1967 W 19 Apr 1967 L	
Burma		S: 14 Aug 1963 LMW R: 15 Nov 1963 LMW	S: 22 May 1967 LMW R: 18 Mar 1970 LMW	
Burundi		S: 4 Oct 1963 W	S: 27 Jan 1967 W	
Byelorussia		S: 8 Oct 1963 M R:[3] 16 Dec 1963 M	S: 10 Feb 1967 M R:[3] 31 Oct 1967 M	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 W R: 31 Oct 1972 W	S: 18 Mar 1971 W	S: 10 Apr 1972 W R: 25 Apr 1975 W	S: 10 Jun 1977
		R: 8 Jun 1978 W	
S: 1 Jul 1968 W R: 26 May 1970 W	S: 11 Feb 1971 LMW	S: 10 Apr 1972 W R: 30 Oct 1975 W	S: 18 May 1977
S: 1 Jul 1968 W R: 28 Apr 1969 L	S: 11 Feb 1971 W R: 10 Nov 1972 W	S: 10 Apr 1972 W	
	S:[2] 3 Sep 1971 LMW	S: 10 Apr 1972 LMW R: 27 Feb 1973 LMW	S: 9 Nov 1977
S: 1 Jul 1968 LMW R: 5 Sep 1969 W 18 Sep 1969 M 3 Nov 1969 L S.A.: 29 Feb 1972	S: 11 Feb 1971 LMW R: 16 Apr 1971 M 7 May 1971 W 26 May 1971 L	S: 10 Apr 1972 LMW R: 2 Aug 1972 L 13 Sep 1972 W 19 Sep 1972 M	S: 18 May 1977 R: 31 May 1978
	S: 11 Feb 1971 LMW	S: 10 Apr 1972 LMW	
R: 19 Mar 1971 M	S: 11 Feb 1971 MW	S: 10 Apr 1972 MW	
	S: 3 Mar 1971 M R: 14 Sep 1971 M	S: 10 Apr 1972 M R: 26 Mar 1975 M	S: 18 May 1977 R: 7 June 1978

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Cambodia: see Democratic Kampuchea			
Cameroon: see United Republic of Cameroon			
Canada	S: 8 Aug 1963 LMW R: 28 Jan 1964 LMW	S: 27 Jan 1967 LMW R: 10 Oct 1967 LMW	
Cape Verde			
Central African Empire	R: 22 Dec 1964 W 24 Aug 1965 L 25 Sep 1965 M	S: 27 Jan 1967 W	
Chad	S: 26 Aug 1963 W R: 1 Mar 1965 W		
Chile S: 1 Dec 1959 R: 23 Jun 1961	S: 8 Aug 1963 W 9 Aug 1963 LM R: 6 Oct 1965 L	S: 27 Jan 1967 W 3 Feb 1967 L 20 Feb 1967 M	S: 14 Feb 1967 R:[5] 9 Oct 1974
China			P.II:[6] S: 21 Aug 1973 R: 12 Jun 1974

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 23 Jul 1968 LW 29 Jul 1968 M R: 8 Jan 1969 LMW S.A.: 21 Feb 1972	S: 11 Feb 1971 LMW R:[3] 17 May 1972 LMW	S: 10 Apr 1972 LMW R: 18 Sep 1972 LMW	S: 18 May 1977
		R: 20 Oct 1977 M	
R: 25 Oct 1970 W	S: 11 Feb 1971 W	S: 10 Apr 1972 W	
S: 1 Jul 1968 M R: 10 Mar 1971 W 11 Mar 1971 M 23 Mar 1971 L			
		S: 10 Apr 1972 LMW	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Colombia	S: 16 Aug 1963 MW 20 Aug 1963 L	S: 27 Jan 1967 W	S: 14 Feb 1967 R:[2] 4 Aug 1972
Congo			
Costa Rica	S: 9 Aug 1963 L 13 Aug 1963 W 23 Aug 1963 M R: 10 Jul 1967 W		S: 14 Feb 1967 R:[2] 25 Aug 1969
Cuba		R:[4] 3 Jun 1977 M	
Cyprus	S: 8 Aug 1963 LMW R: 15 Apr 1965 L 21 Apr 1965 M 7 May 1965 W	S: 27 Jan 1967 W 15 Feb 1967 M 16 Feb 1967 L R: 5 Jul 1972 LW 20 Sep 1972 M	
Czechoslovakia R: 14 Jun 1962	S: 8 Aug 1963 LMW R: 14 Oct 1963 LM 17 Oct 1963 W	S: 27 Jan 1967 LMW R: 11 May 1967 L 18 May 1967 M 22 May 1967 W	
Dahomey: see Benin			
Democratic Kampuchea (Cambodia)			
Democratic Yemen †			

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 W	S: 11 Feb 1971 W	S: 10 Apr 1972 W	
R: 23 Oct 1978 W	R: 23 Oct 1978 W	R: 23 Oct 1978 W	
S: 1 Jul 1968 W R: 3 Mar 1970 W	S: 11 Feb 1971 W	S: 10 Apr 1972 W R: 17 Dec 1973 W	
	R:[4] 3 Jun 1977 M	S: 12 Apr 1972 M R: 21 Apr 1976 M	S: 23 Sep 1977 R: 10 Apr 1978
S: 1 Jul 1968 LMW R: 10 Feb 1970 M 16 Feb 1970 W 5 Mar 1970 L S.A.: 26 Jan 1973	S: 11 Feb 1971 LMW R: 17 Nov 1971 LM 30 Dec 1971 W	S: 10 Apr 1972 LW 14 Apr 1972 M R: 6 Nov 1973 L 13 Nov 1973 W 21 Nov 1973 M	S: 7 Oct 1977 R: 12 Apr 1978
S: 1 Jul 1968 LMW R: 22 Jul 1969 LMW S.A.: 3 Mar 1972	S: 11 Feb 1971 LMW R: 11 Jan 1972 LMW	S: 10 Apr 1972 LMW R: 30 Apr 1973 LMW	S: 18 May 1977 R: 12 May 1978
R: 2 Jun 1972 W	S: 11 Feb 1971 W	S: 10 Apr 1972 W	
S: 14 Nov 1968 M	S: 23 Feb 1971 M	S: 26 Apr 1972 M	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Denmark			
R: 20 May 1965	S: 9 Aug 1963 LMW R: 15 Jan 1964 LMW	S: 27 Jan 1967 LMW R: 10 Oct 1967 LMW	
Dominican Republic			
	S: 16 Sep 1963 W 17 Sep 1963 L 19 Sep 1963 M R: 3 Jun 1964 M 18 Jun 1964 L 22 Jul 1964 W	S: 27 Jan 1967 W R: 21 Nov 1968 W	S: 28 Jul 1967 R:[2] 14 Jun 1968 S.A.:[15]
Ecuador			
	S: 27 Sep 1963 W 1 Oct 1963 LM R: 6 May 1964 W 8 May 1964 L 13 Nov 1964 M	S: 27 Jan 1967 W 16 May 1967 L 7 Jun 1967 M R: 7 Mar 1969 W	S: 14 Feb 1967 R:[2] 11 Feb 1969 S.A.:[15]
Egypt			
	S:[4] 8 Aug 1963 LMW R: 10 Jan 1964 LMW	S: 27 Jan 1967 MW R: 10 Oct 1967 W 23 Jan 1968 M	
El Salvador			
	S: 21 Aug 1963 W 22 Aug 1963 L 23 Aug 1963 M R: 3 Dec 1964 W 7 Dec 1964 L 9 Feb 1965 M	S: 27 Jan 1967 W R: 15 Jan 1969 W	S: 14 Feb 1967 R:[2] 22 Apr 1968 S.A.:[15]
Equatorial Guinea			
Ethiopia			
	S: 9 Aug 1963 LW 19 Sep 1963 M	S: 27 Jan 1967 LW 10 Feb 1967 M	
Fiji			
	R:[1] 14 Jul 1972 M 18 Jul 1972 W 14 Aug 1972 L	R:[1] 18 Jul 1972 W 14 Aug 1972 L 29 Aug 1972 M	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 LMW R: 3 Jan 1969 LMW S.A.: 21 Feb 1977	S: 11 Feb 1971 LMW R: 15 Jun 1971 LMW	S: 10 Apr 1972 LMW R: 1 Mar 1973 LMW	S: 18 May 1977 R: 19 Apr 1978
S: 1 Jul 1968 W R: 24 Jul 1971 W S.A.: 11 Oct 1973	S: 11 Feb 1971 W R: 11 Feb 1972 W	S: 10 Apr 1972 W R: 23 Feb 1973 W	
S: 9 Jul 1968 W R: 7 Mar 1969 W S.A.: 10 Mar 1975		S: 14 Jun 1972 W R: 12 Mar 1975 W	
S: 1 Jul 1968 LM		S: 10 Apr 1972 LM	
S: 1 Jul 1968 W R: 11 Jul 1972 W S.A.: 22 Apr 1975		S: 10 Apr 1972 W	
	S: 4 Jun 1971 W		
S: 5 Sep 1968 LMW R: 5 Feb 1970 M 5 Mar 1970 LW S.A.: 2 Dec 1977	S: 11 Feb 1971 LMW R: 12 Jul 1977 L 14 Jul 1977 MW	S: 10 Apr 1972 LMW R: 26 May 1975 LM 26 Jun 1975 W	S: 18 May 1977
R:[2] 21 Jul 1972 W 14 Aug 1972 L 29 Aug 1972 M S.A.: 22 Mar 1973		S: 22 Feb 1973 L R: 4 Sep 1973 W 1 Oct 1973 L 5 Oct 1973 M	

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Finland		S: 8 Aug 1963 LMW R: 9 Jan 1964 LMW	S: 27 Jan 1967 LMW R: 12 Jul 1967 LMW	
France	S: 1 Dec 1959 R: 16 Sep 1960		S: 25 Sep 1967 LMW R: 5 Aug 1970 LMW	P.II:[7] S: 18 Jul 1973 R: 22 Mar 1974
Gabon		S: 10 Sep 1963 W R: 20 Feb 1964 W 4 Mar 1964 L 9 Mar 1964 M		
Gambia		R:[1] 27 Apr 1965 MW 6 May 1965 L	S: 2 Jun 1967 L	
German Democratic Republic	R:[1] 19 Nov 1974	S: 8 Aug 1963 M R:[5] 30 Dec 1963 M	S: 27 Jan 1967 M R:[5] 2 Feb 1967 M	
Germany, Federal Republic of		S: 19 Aug 1963 LMW R:[6] 1 Dec 1964 LW	S: 27 Jan 1967 LMW R:[6] 10 Feb 1971 LW	
Ghana		S: 8 Aug 1963 M 9 Aug 1963 W 4 Sep 1963 L R: 27 Nov 1963 L 9 Jan 1964 W 31 May 1965 M	S: 27 Jan 1967 W 15 Feb 1967 M 3 Mar 1967 L	
Greece		S: 8 Aug 1963 W 9 Aug 1963 LM R: 18 Dec 1963 LMW	S: 27 Jan 1967 W R: 19 Jan 1971 L	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 LMW R: 5 Feb 1969 LMW S.A.: 9 Feb 1972	S: 11 Feb 1971 LMW R: 8 Jun 1971 LMW	S: 10 Apr 1972 LMW R: 4 Feb 1974 LMW	S: 18 May 1977 R: 12 May 1978
R: 19 Feb 1974 W		S: 10 Apr 1972 L	
S: 4 Sep 1968 L 20 Sep 1968 W 24 Sep 1968 M R: 12 May 1975 W S.A.: 8 Aug 1978	S: 18 May 1971 L 21 May 1971 M 29 Oct 1971 W	S: 2 Jun 1972 M 8 Aug 1972 L 9 Nov 1972 W	
S: 1 Jul 1968 M R:[3] 31 Oct 1969 M S.A.: 7 Mar 1972	S: 11 Feb 1971 M R: 27 Jul 1971 M	S: 10 Apr 1972 M R: 28 Nov 1972 M	S: 18 May 1977 R: 25 May 1978
S: 28 Nov 1969 LMW R:[4] 2 May 1975 LW S.A.: 21 Feb 1977	S: 8 Jun 1971 LMW R:[5] 18 Nov 1975 LW	S: 10 Apr 1972 LMW	S: 18 May 1977
S: 1 Jul 1968 MW 24 Jul 1968 L R: 4 May 1970 L 5 May 1970 W 11 May 1970 M S.A.: 17 Feb 1975	S: 11 Feb 1971 LMW R: 9 Aug 1972 W	S: 10 Apr 1972 MW R: 6 Jun 1975 L	S: 21 Mar 1978 R: 22 Jun 1978
S: 1 Jul 1968 MW R: 11 Mar 1970 W S.A.: 1 Mar 1972	S: 11 Feb 1971 M 12 Feb 1971 W	S: 10 Apr 1972 L 12 Apr 1972 W 14 Apr 1972 M R: 10 Dec 1975 W	

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Grenada				S: 29 Apr 1975 R:[2] 20 Jun 1975
Guatemala		S: 23 Sep 1963 W R:[2] 6 Jan 1964 W		S: 14 Feb 1967 R:[2] 6 Feb 1970
Guinea				
Guinea-Bissau		R: 20 Aug 1976 M	R: 20 Aug 1976 M	
Guyana			S: 3 Feb 1967 W	
Haiti		S: 9 Oct 1963 W	S: 27 Jan 1967 W	S: 14 Feb 1967 R:[2] 23 May 1969
Holy See (Vatican City)			S: 5 Apr 1967 L	
Honduras		S: 8 Aug 1963 W 15 Aug 1963 L 16 Aug 1963 M R: 2 Oct 1964 W 2 Dec 1964 L	S: 27 Jan 1967 W	S: 14 Feb 1967 R:[2] 23 Sep 1968 S.A.:[15]

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
R:[2] 2 Sep 1975 L 3 Dec 1975 W			
S: 26 Jul 1968 W R: 22 Sep 1970 W	S: 11 Feb 1971 W	S: 9 May 1972 W R: 19 Sep 1973 W	
	S: 11 Feb 1971 MW		
R: 20 Aug 1976 M	R: 20 Aug 1976 M	R: 20 Aug 1976 M	
		S: 3 Jan 1973 W	
S: 1 Jul 1968 W R: 2 Jun 1970 W		S: 10 Apr 1972 W	
R:[5] 25 Feb 1971 LMW .A.: 1 Aug 1972			S: 27 May 1977
: 1 Jul 1968 W R: 16 May 1973 W .A.: 18 Apr 1975	S: 11 Feb 1971 W	S: 10 Apr 1972 W	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Hungary			
	S: 8 Aug 1963 LMW R: 21 Oct 1963 L 22 Oct 1963 W 23 Oct 1963 M	S: 27 Jan 1967 LMW R: 26 Jun 1967 LMW	
Iceland			
	S: 12 Aug 1963 LMW R: 29 Apr 1964 LMW	S: 27 Jan 1967 LMW R: 5 Feb 1968 LMW	
India			
	S: 8 Aug 1963 LMW R: 10 Oct 1963 L 14 Oct 1963 M 18 Oct 1963 W	S: 3 Mar 1967 LMW	
Indonesia			
	S: 23 Aug 1963 LMW R: 20 Jan 1964 M 27 Jan 1964 W 8 May 1964 L	S: 27 Jan 1967 W 30 Jan 1967 M 14 Feb 1967 L	
Iran			
	S: 8 Aug 1963 LMW R: 5 May 1964 LMW	S: 27 Jan 1967 L	
Iraq			
	S: 13 Aug 1963 LMW R: 30 Nov 1964 L 1 Dec 1964 W 3 Dec 1964 M	S: 27 Feb 1967 LW 9 Mar 1967 M R: 4 Dec 1968 M 23 Sep 1969 L	
Ireland			
	S: 8 Aug 1963 LW 9 Aug 1963 M R: 18 Dec 1963 LW 20 Dec 1963 M	S: 27 Jan 1967 LW R: 17 Jul 1968 W 19 Jul 1968 L	
Israel			
	S: 8 Aug 1963 LMW R: 15 Jan 1964 LW 28 Jan 1964 M	S: 27 Jan 1967 LMW R: 18 Feb 1977 W 1 Mar 1977 L 4 Apr 1977 M	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 LMW R: 27 May 1969 LMW S.A.: 30 Mar 1972	S: 11 Feb 1971 LMW R: 13 Aug 1971 LMW	S: 10 Apr 1972 LMW R: 27 Dec 1972 LMW	S: 18 May 1977 R: 19 Apr 1978
S: 1 Jul 1968 LMW R: 18 Jul 1969 LMW S.A.: 16 Oct 1974	S: 11 Feb 1971 LMW R: 30 May 1972 LMW	S: 10 Apr 1972 LMW R: 15 Feb 1973 LMW	S: 18 May 1977
	R:[6] 20 Jul 1973 LMW	S:[2] 15 Jan 1973 LMW R:[2] 15 Jul 1974 LMW	S: 15 Dec 1977 R: 15 Dec 1978
S:[6] 2 Mar 1970 LMW		S: 20 Jun 1972 MW 21 Jun 1972 L	
S: 1 Jul 1968 LMW R: 2 Feb 1970 W 10 Feb 1970 M 5 Mar 1970 L S.A.: 15 May 1974	S: 11 Feb 1971 LMW R: 26 Aug 1971 LW 6 Sep 1972 M	S: 10 Apr 1972 MW 16 Nov 1972 L R: 22 Aug 1973 LW 27 Aug 1973 M	S: 18 May 1977
S: 1 Jul 1968 M R: 29 Oct 1969 M S.A.: 29 Feb 1972	S: 22 Feb 1971 M R:[4] 13 Sep 1972 M	S: 11 May 1972 M	S: 15 Aug 1977
S: 1 Jul 1968 MW 4 Jul 1968 L R: 1 Jul 1968 W 2 Jul 1968 M 4 Jul 1968 L S.A.: 21 Feb 1977	S: 11 Feb 1971 LW R: 19 Aug 1971 LW	S:[3] 10 Apr 1972 LW R: 27 Oct 1972 LW	S: 18 May 1977

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Italy		S: 8 Aug 1963 LMW R: 10 Dec 1964 LMW	S: 27 Jan 1967 LMW R: 4 May 1972 LMW	
Ivory Coast		S: 5 Sep 1963 W R: 5 Feb 1965 W		
Jamaica		S: 13 Aug 1963 LMW	S: 29 Jun 1967 LMW R: 6 Aug 1970 W 10 Aug 1970 L 21 Aug 1970 M	S: 26 Oct 1967 R:[2] 26 Jun 1969 S.A.:[15]
Japan	S: 1 Dec 1959 R: 4 Aug 1960	S: 14 Aug 1963 LMW R: 15 Jun 1964 LMW	S: 27 Jan 1967 LMW R: 10 Oct 1967 LMW	
Jordan		S: 12 Aug 1963 LW 19 Aug 1963 M R: 29 May 1964 L 7 Jul 1964 M 10 Jul 1964 W	S: 2 Feb 1967 W	
Kampuchea: see Democratic Kampuchea				
Kenya		R: 10 Jun 1965 L 11 Jun 1965 W 30 Jun 1965 M		
Korea, South		S: 30 Aug 1963 LW R:[2] 24 Jul 1964 LW	S: 27 Jan 1967 W R:[4] 13 Oct 1967 W	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 28 Jan 1969 LMW R:[7] 2 May 1975 LW 4 May 1975 M S.A.: 21 Feb 1977	S:[7] 11 Feb 1971 LMW R:[7] 3 Sep 1974 LMW	S: 10 Apr 1972 LMW R: 30 May 1975 LMW	S: 18 May 1977
S: 1 Jul 1968 W R: 6 Mar 1973 W	R: 14 Jan 1972 W	S: 23 May 1972 W	
S: 14 Apr 1969 LMW R: 5 Mar 1970 LMW S.A.: 6 Nov 1978	S: 11 Oct 1971 LW 14 Oct 1971 M	R: 13 Aug 1975 L	
S: 3 Feb 1970 LMW R:[8] 8 Jun 1976 LMW S.A.: 2 Dec 1977	S: 11 Feb 1971 LMW R: 21 Jun 1971 LMW	S: 10 Apr 1972 LMW	
S: 10 Jul 1968 W R: 11 Feb 1970 W S.A.: 21 Feb 1978	S: 11 Feb 1971 LMW R: 17 Aug 1971 W 30 Aug 1971 M 1 Nov 1971 L	S: 10 Apr 1972 W 17 Apr 1972 L 24 Apr 1972 M R: 30 May 1975 M 2 Jun 1975 W 27 Jun 1975 L	
S: 1 Jul 1968 W R: 11 Jun 1970 M		R: 7 Jan 1976 L	
S:[9] 1 Jul 1968 W R:[10] 23 Apr 1975 W S.A.: 14 Nov 1975	S:[4] 11 Feb 1971 LW	S:[4] 10 Apr 1972 LW	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Kuwait	S:[7] 20 Aug 1963 LMW R: 20 May 1965 W 21 May 1965 L 17 Jun 1965 M	R:[7] 7 Jun 1972 W 20 Jun 1972 L 4 Jul 1972 M	
Lao People's Democratic Republic	S: 12 Aug 1963 LMW R: 10 Feb 1965 L 12 Feb 1965 W 7 Apr 1965 M	S: 27 Jan 1967 W 30 Jan 1967 L 2 Feb 1967 M R: 27 Nov 1972 M 29 Nov 1972 W 15 Jan 1973 L	
Lebanon	S: 12 Aug 1963 W 13 Aug 1963 LM R: 14 May 1965 W 20 May 1965 L 4 Jun 1965 M	S: 23 Feb 1967 LMW R: 31 Mar 1969 LM 30 Jun 1969 W	
Lesotho		S: 27 Jan 1967 W	
Liberia	S: 8 Aug 1963 W 16 Aug 1963 L 27 Aug 1963 M R: 19 May 1964 W 22 May 1964 L 16 Jun 1964 M		
Libya	S: 9 Aug 1963 L 16 Aug 1963 MW R: 15 Jul 1968 L	R: 3 Jul 1968 W	
Liechtenstein			
Luxembourg	S: 13 Aug 1963 L 3 Sep 1963 W 13 Sep 1963 M R: 10 Feb 1965 LMW	S: 27 Jan 1967 MW 31 Jan 1967 L	
Madagascar	S: 23 Sep 1963 W R: 15 Mar 1965 W	R:[8] 22 Aug 1968 W	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 15 Aug 1968 MW 22 Aug 1968 L		S: 14 Apr 1972 MW 27 Apr 1972 L R:[5] 18 Jul 1972 W 26 Jul 1972 L 1 Aug 1972 M	
S: 1 Jul 1968 LMW R: 20 Feb 1970 M 5 Mar 1970 LW	S: 11 Feb 1971 LW 15 Feb 1971 M R: 19 Oct 1971 L 22 Oct 1971 M 3 Nov 1971 W	S: 10 Apr 1972 LMW R: 20 Mar 1973 M 22 Mar 1973 W 25 Apr 1973 L	S: 13 Apr 1978 R: 5 Oct 1978
S: 1 Jul 1968 LMW R: 15 Jul 1970 LM 20 Nov 1970 W S.A.: 5 Mar 1973	S: 11 Feb 1971 LMW	S: 10 Apr 1972 LW 21 Apr 1972 M R: 26 Mar 1975 L 2 Apr 1975 M 13 Jun 1975 W	S: 18 May 1977
S: 9 Jul 1968 W R: 20 May 1970 W S.A.: 12 Jun 1973	S: 8 Sep 1971 W R: 3 Apr 1973 W	S: 10 Apr 1972 W R: 6 Sep 1977 L	
S: 1 Jul 1968 W R: 5 Mar 1970 W	S: 11 Feb 1971 W	S: 10 Apr 1972 W 14 Apr 1972 L	S: 18 May 1977
S: 18 Jul 1968 L 19 Jul 1968 W 23 Jul 1968 M R: 26 May 1975 LMW			
R:[12] 20 Apr 1978 LMW			
S: 14 Aug 1968 LMW R: 2 May 1975 LW 4 May 1975 M S.A.: 21 Feb 1977	S: 11 Feb 1971 LMW	S: 10 Apr 1972 LM 12 Apr 1972 W R: 23 Mar 1976 LMW	S: 18 May 1977
S: 22 Aug 1968 W R: 8 Oct 1970 W S.A.: 14 Jun 1973	S: 14 Sep 1971 W	S: 13 Oct 1972 L	

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Malawi		R:[1] 26 Nov 1964 MW 7 Jan 1965 L		
Malaysia		S: 8 Aug 1963 W 12 Aug 1963 L 21 Aug 1963 M R: 15 Jul 1964 M 16 Jul 1964 LW	S: 20 Feb 1967 W 21 Feb 1967 L 3 May 1967 M	
Maldives				
Mali		S: 23 Aug 1963 LMW	R: 11 Jun 1968 M	
Malta		R:[1] 25 Nov 1964 MW 1 Dec 1964 L		
Mauritania		S: 13 Sep 1963 W 17 Sep 1963 L 8 Oct 1963 M R: 6 Apr 1964 W 15 Apr 1964 L 28 Apr 1964 M		
Mauritius		R:[1] 30 Apr 1969 MW 12 May 1969 L	R:[1] 16 Apr 1969 W 21 Apr 1969 L 13 May 1969 M	
Mexico		S: 8 Aug 1963 LMW R: 27 Dec 1963 LMW	S: 27 Jan 1967 LMW R: 31 Jan 1968 LMW	S:[8] 14 Feb 1967 R:[2] 20 Sep 1967 S.A.: 6 Sep 1968

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
		S: 10 Apr 1972 W	
S: 1 Jul 1968 LMW R: 5 Mar 1970 LMW S.A.: 29 Feb 1972	S: 20 May 1971 LMW R: 21 Jun 1972 LMW	S: 10 Apr 1972 LMW	
S: 11 Sep 1968 W R: 7 Apr 1970 W S.A.: 2 Oct 1977			
S: 14 Jul 1969 W 15 Jul 1969 M R: 10 Feb 1970 M 5 Mar 1970 W	S: 11 Feb 1971 W 15 Feb 1971 M	S: 10 Apr 1972 W	
S: 17 Apr 1969 W R: 6 Feb 1970 W	S: 11 Feb 1971 LW R: 4 May 1971 W	S: 11 Sep 1972 L R: 7 Apr 1975 L	
S: 1 Jul 1968 W R: 8 Apr 1969 W 14 Apr 1969 L 25 Apr 1969 M S.A.: 31 Jan 1973	S: 11 Feb 1971 W R: 23 Apr 1971 W 3 May 1971 L 18 May 1971 M	S: 10 Apr 1972 W R: 7 Aug 1972 W 11 Jan 1973 L 15 Jan 1973 M	
S:[11] 26 Jul 1968 LMW R: 21 Jan 1969 LMW S.A.: 14 Sep 1973		S:[6] 10 Apr 1972 LMW R: 8 Apr 1974 LMW	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Mongolia			
	S: 8 Aug 1963 LM R: 1 Nov 1963 M 7 Nov 1963 L	S: 27 Jan 1967 M R: 10 Oct 1967 M	
Morocco			
	S: 27 Aug 1963 MW 30 Aug 1963 L R: 1 Feb 1966 L 18 Feb 1966 M 21 Feb 1966 W	R: 21 Dec 1967 LM 22 Dec 1967 W	
Nepal			
	S: 26 Aug 1963 LM 30 Aug 1963 W R: 7 Oct 1964 LMW	S: 3 Feb 1967 MW 6 Feb 1967 L R: 10 Oct 1967 L 16 Oct 1967 M 22 Nov 1967 W	
Netherlands R: 30 Mar 1967	S: 9 Aug 1963 LMW R: 14 Sep 1964 LMW	S: 10 Feb 1967 LMW R: 10 Oct 1969 LMW	P.I.:[9] S: 15 Mar 1968 R: 26 Jul 1971
New Zealand S: 1 Dec 1959 R: 1 Nov 1960	S: 8 Aug 1963 LMW R: 10 Oct 1963 LW 16 Oct 1963 M	S: 27 Jan 1967 LMW R: 31 May 1968 LMW	
Nicaragua			
	S: 13 Aug 1963 LW 16 Aug 1963 M R: 26 Jan 1965 L 26 Feb 1965 MW	S: 27 Jan 1967 W 13 Feb 1967 L	S: 15 Feb 1967 R:[2,10] 14 Oct 1968 S.A.:[15]
Niger			
	S: 24 Sep 1963 LW R: 3 Jul 1964 M 6 Jul 1964 L 9 Jul 1964 W	S: 1 Feb 1967 W R: 17 Apr 1967 L 3 May 1967 W	
Nigeria			
	S: 30 Aug 1963 M 2 Sep 1963 L 4 Sep 1963 W R: 17 Feb 1967 L 25 Feb 1967 M 28 Feb 1967 W	R: 14 Nov 1967 L	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 M R: 14 May 1969 M S.A.: 5 Sep 1972	S: 11 Feb 1971 LM R: 8 Oct 1971 M 15 Nov 1971 L	S: 10 Apr 1972 LMW R: 5 Sep 1972 W 14 Sep 1972 L 20 Oct 1972 M	S: 18 May 1977 R: 19 May 1978
S: 1 Jul 1968 LMW R: 27 Nov 1970 M 30 Nov 1970 L 16 Dec 1970 W S.A.: 18 Feb 1975	S: 11 Feb 1971 MW 18 Feb 1971 L R: 26 Jul 1971 L 5 Aug 1971 W 18 Jan 1972 M	S: 2 May 1972 L 3 May 1972 W 5 Jun 1972 M	S: 18 May 1977
S: 1 Jul 1968 LMW R: 5 Jan 1970 W 9 Jan 1970 M 3 Feb 1970 L S.A.: 22 Jun 1972	S: 11 Feb 1971 MW 24 Feb 1971 L R: 6 Jul 1971 L 29 Jul 1971 M 9 Aug 1971 W	S: 10 Apr 1972 LMW	
S: 20 Aug 1968 LMW R: 2 May 1975 LMW S.A.: 21 Feb 1977	S: 11 Feb 1971 LMW R: 14 Jan 1976 LMW	S: 10 Apr 1972 LMW	S: 18 May 1977
S: 1 Jul 1968 LMW R: 10 Sep 1969 LMW S.A.: 29 Feb 1972	S: 11 Feb 1971 LMW R: 24 Feb 1972 LMW	S: 10 Apr 1972 LMW R: 13 Dec 1972 W 18 Dec 1972 L 10 Jan 1973 M	
S: 1 Jul 1968 LW R: 6 Mar 1973 W S.A.: 29 Dec 1976	S: 11 Feb 1971 W R: 7 Feb 1973 W	S: 10 Apr 1972 LW R: 7 Aug 1975 W	S: 11 Aug 1977
	S: 11 Feb 1971 W R: 9 Aug 1971 W	S: 21 Apr 1972 W R: 23 Jun 1972 W	
S: 1 Jul 1968 LMW R: 27 Sep 1968 L 7 Oct 1968 W 14 Oct 1968 M		S: 3 Jul 1972 M 10 Jul 1972 L 6 Dec 1972 W R: 3 Jul 1973 W 9 Jul 1973 L 20 Jul 1973 M	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Norway			
S: 1 Dec 1959 R: 24 Aug 1960	S: 9 Aug 1963 LMW R: 21 Nov 1963 LMW	S: 3 Feb 1967 LMW R: 1 Jul 1969 LMW	
Pakistan			
	S: 14 Aug 1963 LMW	S: 12 Sep 1967 LMW R: 8 Apr 1968 LMW	
Panama			
	S: 20 Sep 1963 W R: 24 Feb 1966 W	S: 27 Jan 1967 W	S: 14 Feb 1967 R:[2] 11 Jun 1971
Paraguay			
	S: 15 Aug 1963 LW 21 Aug 1963 M		S: 26 Apr 1967 R:[2] 19 Mar 1969
Peru			
	S: 23 Aug 1963 LMW R: 20 Jul 1964 W 4 Aug 1964 L 21 Aug 1964 M	S: 30 Jun 1967 W	S: 14 Feb 1967 R:[2] 4 Mar 1969
Philippines			
	S: 8 Aug 1963 LW 14 Aug 1963 M R:[2] 10 Nov 1965 L 15 Nov 1965 W 8 Feb 1966 M	S: 27 Jan 1967 LW 29 Apr 1967 M	
Poland			
R: 8 Jun 1961	S: 8 Aug 1963 LMW R: 14 Oct 1963 LMW	S: 27 Jan 1967 LMW R: 30 Jan 1968 LMW	
Portugal			
	S: 9 Oct 1963 LW		

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 1 Jul 1968 LMW R: 5 Feb 1969 LMW S.A.: 1 Mar 1972	S: 11 Feb 1971 LMW R: 28 Jun 1971 LM 29 Jun 1971 W	S: 10 Apr 1972 LMW R: 1 Aug 1973 LW 23 Aug 1973 M	S: 18 May 1977
		S: 10 Apr 1972 LMW R: 25 Sep 1974 M 3 Oct 1974 LW	
S: 1 Jul 1968 W R: 13 Jan 1977 W	S: 11 Feb 1971 W R: 20 Mar 1974 W	S: 2 May 1972 W R: 20 Mar 1974 W	
S: 1 Jul 1968 W R: 4 Feb 1970 W 5 Mar 1970 L	S: 23 Feb 1971 W	R: 9 Jun 1976 W	
S: 1 Jul 1968 W R: 3 Mar 1970 W		S: 10 Apr 1972 LMW	
S: 1 Jul 1968 W 18 Jul 1968 M R: 5 Oct 1972 W 16 Oct 1972 L 20 Oct 1972 M S.A.: 16 Oct 1974		S: 10 Apr 1972 LW 21 Jun 1972 M R: 21 May 1973 W	
S: 1 Jul 1968 LMW R: 12 Jun 1969 LMW S.A.: 11 Oct 1972	S: 11 Feb 1971 LMW R: 15 Nov 1971 LMW	S: 10 Apr 1972 LMW R: 25 Jan 1973 LMW	S: 18 May 1977 R: 8 Jun 1978
R: 15 Dec 1977 LMW	R: 24 Jun 1975 LMW	S: 29 Jun 1972 W R: 15 May 1975 LMW	S: 18 May 1977

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Qatar			
Romania			
R:[2] 15 Sep 1971	S: 8 Aug 1963 LMW R: 12 Dec 1963 LMW	S: 27 Jan 1967 LMW R: 9 Apr 1968 LMW	
Rwanda			
	S: 19 Sep 1963 W R: 22 Oct 1963 L 16 Dec 1963 M 27 Dec 1963 W	S: 27 Jan 1967 W	
Samoa			
	S: 5 Sep 1963 L 6 Sep 1963 MW R: 15 Jan 1965 W 19 Jan 1965 L 8 Feb 1965 M		
San Marino			
	S: 17 Sep 1963 W 20 Sep 1963 L 24 Sep 1963 M R: 3 Jul 1964 L 9 Jul 1964 W 27 Nov 1964 M	S: 21 Apr 1967 W 24 Apr 1967 L 6 Jun 1967 M R: 29 Oct 1968 W 21 Nov 1968 M 3 Feb 1969 L	
Saudi Arabia			
		R: 17 Dec 1976 W	
Senegal			
	S: 20 Sep 1963 W 23 Sep 1963 L 9 Oct 1963 M R: 6 May 1964 L 12 May 1964 M 2 Jun 1964 W		
Seychelles			
		R: 5 Jan 1978 L	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
	R: 12 Nov 1974 L	S: 14 Nov 1972 L R: 17 Apr 1975 L	
S: 1 Jul 1968 LMW R: 4 Feb 1970 LMW S.A.: 27 Oct 1972	S: 11 Feb 1971 LMW R:[8] 10 Jul 1972 LMW	S: 10 Apr 1972 LMW	S: 18 May 1977
R: 20 May 1975 LMW	S: 11 Feb 1971 W R: 20 May 1975 LMW	S: 10 Apr 1972 MW R: 20 May 1975 LMW	
R: 17 Mar 1975 M 18 Mar 1975 W 26 Mar 1975 L			
S:[9] 1 Jul 1968 W 29 Jul 1968 L 21 Nov 1968 M R: 10 Aug 1970 L 20 Aug 1970 M 31 Aug 1970 W		S: 12 Sep 1972 W 30 Jan 1973 M 21 Mar 1973 L R: 11 Mar 1975 L 17 Mar 1975 W 27 Mar 1975 M	
	S: 7 Jan 1972 W R: 23 Jun 1972 W	S: 12 Apr 1972 W R: 24 May 1972 W	
S: 1 Jul 1968 MW 26 Jul 1968 L R: 17 Dec 1970 M 22 Dec 1970 W 15 Jan 1971 L	S: 17 Mar 1971 W	S: 10 Apr 1972 W R: 26 Mar 1975 W	
	R: 29 Jun 1976 W		

	Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Sierra Leone		S: 4 Sep 1963 L 9 Sep 1963 M 11 Sep 1963 W R: 21 Feb 1964 L 4 Mar 1964 W 29 Apr 1964 M	S: 27 Jan 1967 LM 16 May 1967 W R: 13 Jul 1967 M 14 Jul 1967 W 25 Oct 1967 L	
Singapore		R:[1] 12 Jul 1968 MW 23 Jul 1968 L	R: 10 Sep 1976 LMW	
Somalia		S: 19 Aug 1963 MW	S: 2 Feb 1967 W	
South Africa	S: 1 Dec 1959 R: 21 Jun 1960	R: 10 Oct 1963 LW 22 Nov 1963 M	S: 1 Mar 1967 W R: 30 Sep 1968 W 8 Oct 1968 L	
Spain		S: 13 Aug 1963 W 14 Aug 1963 L R: 17 Dec 1964 LW	R: 27 Nov 1968 L 7 Dec 1968 W	
Sri Lanka		S: 22 Aug 1963 LW 23 Aug 1963 M R: 5 Feb 1964 W 12 Feb 1964 M 13 Feb 1964 L	S: 10 Mar 1967 L	
Sudan		S: 9 Aug 1963 LMW R: 4 Mar 1966 LW 28 Mar 1966 M		
Suriname				S: 13 Feb 1976 R:[2] 10 Jun 1977 S.A.:[15]

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
R: 26 Feb 1975 LMW	S: 11 Feb 1971 L 12 Feb 1971 M 24 Feb 1971 W	S: 7 Nov 1972 W 24 Nov 1972 L R: 29 Jun 1976 LMW	S: 12 Apr 1978
S: 5 Feb 1970 LMW R: 10 Mar 1976 LMW S.A.: 18 Oct 1977	S: 5 May 1971 LMW R: 10 Sep 1976 LMW	S: 19 Jun 1972 LMW R: 2 Dec 1975 LMW	
S: 1 Jul 1968 LMW R: 5 Mar 1970 L 12 Nov 1970 W		S: 3 Jul 1972 M	
	S: 11 Feb 1971 W R: 14 Nov 1973 W 26 Nov 1973 L	S: 10 Apr 1972 W R: 3 Nov 1975 W	
		S: 10 Apr 1972 LW	S: 18 May 1977 R: 19 Jul 1978
S: 1 Jul 1968 LMW		S: 10 Apr 1972 LMW	S: 8 Jun 1977 R: 25 Apr 1978
S: 24 Dec 1968 M R: 31 Oct 1973 W 22 Nov 1973 M 10 Dec 1973 L S.A.: 7 Jan 1977	S: 11 Feb 1971 L 12 Feb 1971 M		
R:[2] 30 Jun 1976 W S.A.: 5 Jun 1975			

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Swaziland	R: 29 May 1969 LW 3 Jun 1969 M		
Sweden	S: 12 Aug 1963 LMW R: 9 Dec 1963 LMW	S: 27 Jan 1967 LMW R: 11 Oct 1967 LMW	
Switzerland	S: 26 Aug 1963 LMW R: 16 Jan 1964 LMW	S: 27 Jan 1967 LW 30 Jan 1967 M R: 18 Dec 1969 LMW	
Syria	S: 13 Aug 1963 LMW R: 1 Jun 1964 LMW	R:[9] 14 Nov 1968 M	
Taiwan	S: 23 Aug 1963 W R: 18 May 1964 W	S: 27 Jan 1967 W R: 24 Jul 1970 W	
Tanzania: see United Republic of Tanzania			
Thailand	S: 8 Aug 1963 LMW R: 15 Nov 1963 L 21 Nov 1963 M 29 Nov 1963 W	S: 27 Jan 1967 LMW R: 5 Sep 1968 L 9 Sep 1968 M 10 Sep 1968 W	
Togo	S: 18 Sep 1963 W R: 7 Dec 1964 W	S: 27 Jan 1967 W	

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 24 Jun 1969 L R: 11 Dec 1969 L 16 Dec 1969 W 12 Jan 1970 M S.A.: 28 Jul 1975	S: 11 Feb 1971 W R: 9 Aug 1971 W		
S: 19 Aug 1968 LMW R: 9 Jan 1970 LMW S.A.: 14 Apr 1975	S: 11 Feb 1971 LMW R: 28 Apr 1972 LMW	S: 27 Feb 1975 LMW R: 5 Feb 1976 LMW	
S: 27 Nov 1969 LMW R:[12] 9 Mar 1977 LMW S.A.: 6 Sep 1978	S: 11 Feb 1971 LMW R: 4 May 1976 LMW	S: 10 Apr 1972 LMW R:[7] 4 May 1976 LMW	
S: 1 Jul 1968 M R:[9] 24 Sep 1969 M		S: 14 Apr 1972 M	S: 4 Aug 1977
S: 1 Jul 1968 W R: 27 Jan 1970 W	S: 11 Feb 1971 W R: 22 Feb 1972 W	S: 10 Apr 1972 W R:[8] 9 Feb 1973 W	
R: 7 Dec 1972 L S.A.: 16 May 1974		S: 17 Jan 1973 W R: 28 May 1975 W	
S: 1 Jul 1968 W R: 26 Feb 1970 W	S: 2 Apr 1971 W R: 28 Jun 1971 W	S: 10 Apr 1972 W R: 10 Nov 1976 W	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Tonga	R:[1] 22 Jun 1971 M 7 Jul 1971 LW	R:[1] 22 Jun 1971 L 7 Jul 1971 W 24 Aug 1971 M	
Trinidad and Tobago	S: 12 Aug 1963 LW 13 Aug 1963 M R: 14 Jul 1964 W 16 Jul 1964 L 6 Aug 1964 M	S: 24 Jul 1967 L 17 Aug 1967 M 28 Sep 1967 W	S: 27 Jun 1967 R:[2] 3 Dec 1970
Tunisia	S: 8 Aug 1963 W 12 Aug 1963 L 13 Aug 1963 M R: 26 May 1965 LM 3 Jun 1965 W	S: 27 Jan 1967 LW 15 Feb 1967 M R: 28 Mar 1968 L 4 Apr 1968 M 17 Apr 1968 W	
Turkey	S: 9 Aug 1963 LMW R: 8 Jul 1965 LMW	S: 27 Jan 1967 LMW R: 27 Mar 1968 LMW	
Uganda	S: 29 Aug 1963 LW R: 24 Mar 1964 L 2 Apr 1964 W	R: 24 Apr 1968 W	
Ukraine	S: 8 Oct 1963 M R:[3] 30 Dec 1963 M	S: 10 Feb 1967 M R:[3] 31 Oct 1967 M	
Union of Soviet Socialist Republics S: 1 Dec 1959 R: 2 Nov 1960	S: 5 Aug 1963 M R: 10 Oct 1963 LMW	S: 27 Jan 1967 LMW R: 10 Oct 1967 LMW	P.II:[11] S: 18 May 1978 R: 8 Jan 1979
United Arab Emirates			

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
R:[2] 7 Jul 1971 L 15 Jul 1971 W 24 Aug 1971 M		R: 28 Sep 1976 L	
S: 20 Aug 1968 W 22 Aug 1968 L			
S: 1 Jul 1968 LMW R: 26 Feb 1970 LMW	S: 11 Feb 1971 LMW R: 22 Oct 1971 M 28 Oct 1971 L 29 Oct 1971 W	S: 10 Apr 1972 LMW R: 18 May 1973 W 30 May 1973 M 6 Jun 1973 L	S: 11 May 1978 R: 11 May 1978
S: 28 Jan 1969 LMW	S: 25 Feb 1971 LMW R: 19 Oct 1972 W 25 Oct 1972 L 30 Oct 1972 M	S: 10 Apr 1972 LMW R: 25 Oct 1974 M 4 Nov 1974 L 5 Nov 1974 W	S:[1] 18 May 1977
			S: 18 May 1977
	S: 3 Mar 1971 M R: 3 Sep 1971 M	S: 10 Apr 1972 M R: 26 Mar 1975 M	S: 18 May 1977 R: 13 Jun 1978
S: 1 Jul 1968 LMW R: 5 Mar 1970 LMW	S: 11 Feb 1971 LMW R: 18 May 1972 LMW	S: 10 Apr 1972 LMW R: 26 Mar 1975 LMW	S: 18 May 1977 R: 30 May 1978
		S: 28 Sep 1972 L	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
United Kingdom S: 1 Dec 1959 R: 31 May 1960	S: 5 Aug 1963 M R:[8] 10 Oct 1963 LMW	S: 27 Jan 1967 LMW R:[10] 10 Oct 1967 LMW	P.I:[12] S: 20 Dec 1967 R: 11 Dec 1969 P.II:[12] S: 20 Dec 1967 R: 11 Dec 1969
United Republic of Cameroon	S:[2] 27 Aug 1963 W 6 Sep 1963 L	S: 27 Jan 1967 W	
United Republic of Tanzania	S: 16 Sep 1963 L 18 Sep 1963 W 20 Sep 1963 M R: 6 Feb 1964 L		
United States S: 1 Dec 1959 R: 18 Aug 1960	S: 5 Aug 1963 M R: 10 Oct 1963 LMW	S: 27 Jan 1967 LMW R: 10 Oct 1967 LMW	P.I: S: 26 May 1977 P.II:[13] S: 1 Apr 1968 R: 12 May 1971
Upper Volta	S: 30 Aug 1963 W	S: 3 Mar 1967 W R: 18 Jun 1968 W	
Uruguay	S: 12 Aug 1963 W 27 Sep 1963 LM R: 25 Feb 1969 L	S: 27 Jan 1967 W 30 Jan 1967 M R: 31 Aug 1970 W	S: 14 Feb 1967 R:[2] 20 Aug 1968 S.A.:[15]
Venezuela	S: 16 Aug 1963 MW 20 Aug 1963 L R: 22 Feb 1965 M 3 Mar 1965 L 29 Mar 1965 W	S: 27 Jan 1967 W R: 3 Mar 1970 W	S: 14 Feb 1967 R:[2,14] 23 Mar 1970
Viet Nam*			

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
: 1 Jul 1968 LMW R:[13] 27 Nov 1968 LW 29 Nov 1968 M S.A.:[14] 14 Aug 1978	S: 11 Feb 1971 LMW R:[9] 18 May 1972 LMW	S: 10 Apr 1972 LMW R:[9] 26 Mar 1975 LMW	S: 18 May 1977 R: 16 May 1978
: 17 Jul 1968 W 18 Jul 1968 M R: 8 Jan 1969 W	S: 11 Nov 1971 M		
	S: 11 Feb 1971 W	S: 16 Aug 1972 L	
: 1 Jul 1968 LMW R: 5 Mar 1970 LMW S.A.:[15]	S: 11 Feb 1971 LMW R: 18 May 1972 LMW	S: 10 Apr 1972 LMW R: 26 Mar 1975 LMW	S: 18 May 1977
: 25 Nov 1968 W 11 Aug 1969 M R: 3 Mar 1970 W			
: 1 Jul 1968 W R: 31 Aug 1970 W S.A.: 17 Sep 1976	S: 11 Feb 1971 W		
: 1 Jul 1968 W R: 25 Sep 1975 L 26 Sep 1975 W 3 Oct 1975 M		S: 10 Apr 1972 W R: 18 Oct 1978 LMW	

Antarctic Treaty	Partial Test Ban Treaty	Outer Space Treaty	Treaty of Tlatelolco
Yemen†			
	S: 13 Aug 1963 M 6 Sep 1963 W		
Yugoslavia			
	S: 8 Aug 1963 LMW R: 15 Jan 1964 L 31 Jan 1964 M 3 Apr 1964 W	S: 27 Jan 1967 LMW	
Zaire			
	S: 9 Aug 1963 LW 12 Aug 1963 M R: 28 Oct 1965 W	S: 27 Jan 1967 W 29 Apr 1967 M 4 May 1967 L	
Zambia			
	R:[1] 11 Jan 1965 MW 8 Feb 1965 L	R: 20 Aug 1973 W 21 Aug 1973 M 28 Aug 1973 L	

* South Viet Nam signed the Partial Test Ban Treaty (on 1 October 1963), the Outer Space Treaty (on 27 Januar 1967), the Non-Proliferation Treaty (on 1 July 1968), the Sea-Bed Treaty (on 11 February 1971) and the BV Convention (on 10 April 1972); it ratified the Non-Proliferation Treaty (on 10 September 1971) and concluded a safeguards agreement with the IAEA under that Treaty (on 9 January 1974). On 30 April 1975, the Republic o South Viet Nam ceased to exist as a separate political entity. As from 2 July 1976, North and South Viet Nan constitute a single state under the official name of the Socialist Republic of Viet Nam. The government of th unified state may decide whether it will adhere to international commitments undertaken by the former adminis tration.

† Yemen refers to the Yemen Arab Republic (Northern Yemen). Democratic Yemen refers to the People's Demo cratic Republic of Yemen (Southern Yemen).

The Antarctic Treaty

[1] The German Democratic Republic stated that in its view Article XIII, paragraph I of the Antarctic Treaty wa inconsistent with the principle that all states whose policies are guided by the purposes and principles of the Unite Nations Charter have a right to become parties to treaties which affect the interests of all states.

[2] Romania stated that the provisions of Article XIII, paragraph 1 of the Antarctic Treaty were not in accordanc with the principle according to which multilateral treaties whose object and purposes concern the internationa community, as a whole, should be open for universal participation.

The Partial Test Ban Treaty

[1] Notification of succession.

[2] With a statement that this does not imply the recognition of any territory or régime not recognized by this state

[3] The United States considers that Byelorussia and Ukraine are already covered by the signature and ratificatio by the USSR.

[4] Egypt stated that its ratification of the Treaty does not mean or imply any recognition of Israel or any treat relations with Israel.

[5] The United States did not accept the notification of signature and deposit of ratification of the Treaty in Moscow by the German Democratic Republic, which it then did not recognize as a state. On 4 September 1974, the tw countries established diplomatic relations with each other.

[6] The Federal Republic of Germany stated that the Treaty applies also to *Land* Berlin.

Non-Proliferation Treaty	Sea-Bed Treaty	BW Convention	ENMOD Convention
S: 23 Sep 1968 M	S: 23 Feb 1971 M	S: 10 Apr 1972 W 17 Apr 1972 M 10 May 1972 L	S: 18 May 1977 R: 20 Jul 1977
S: 10 Jul 1968 LMW R:[16] 4 Mar 1970 W 5 Mar 1970 LM S.A.: 28 Dec 1973	S: 2 Mar 1971 LMW R:[10] 25 Oct 1973 LMW	S: 10 Apr 1972 LMW R: 25 Oct 1973 LMW	
S: 22 Jul 1968 W 26 Jul 1968 M 17 Sep 1968 L R: 4 Aug 1970 W S.A.: 9 Nov 1972		S: 10 Apr 1972 MW R: 16 Sep 1975 L 28 Jan 1977 W	S: 28 Feb 1978
	R: 9 Oct 1972 L 1 Nov 1972 W 2 Nov 1972 M		

[7] Kuwait stated that its signature and ratification of the Treaty does not in any way imply its recognition of Israel, nor does it oblige it to apply the provisions of the Treaty in respect of the said country.
[8] The UK stated its view that if a régime is not recognized as the government of a state, neither signature nor the deposit of any instrument by it nor notification of any of those acts will bring about recognition of that régime by any other state.

The Outer Space Treaty

[1] Notification of succession.
[2] The Brazilian government interprets Article X of the Treaty as a specific recognition that the granting of tracking facilities by the parties to the Treaty shall be subject to agreement between the states concerned.
[3] The United States considers that Byelorussia and Ukraine are already covered by the signature and ratification of the USSR.
[4] With a statement that this does not imply the recognition of any territory or régime not recognized by this state.
[5] The USA stated that this did not imply recognition of the German Democratic Republic. On 4 September 1974, the two countries established diplomatic relations with each other.
[6] The Federal Republic of Germany stated that the Treaty applies also to *Land* Berlin.
[7] Kuwait acceded to the Treaty with the understanding that this does not in any way imply its recognition of Israel and does not oblige it to apply the provisions of the Treaty in respect of the said country.
[8] Madagascar acceded to the Treaty with the understanding that under Article X of the Treaty the state shall retain its freedom of decision with respect to the possible installation of foreign observation bases in its territory and shall continue to possess the right to fix, in each case, the conditions for such installation.
[9] Syria acceded to the Treaty with the understanding that this should not mean in any way the recognition of Israel, nor should it lead to any relationship with Israel that could arise from the Treaty.
[10] On depositing its instrument of ratification, the United Kingdom declared that the Treaty will not be applicable in regard to Southern Rhodesia unless and until the United Kingdom informs the other depositary governments that it is in a position to ensure that the obligations imposed by the Treaty in respect of that territory can be fully implemented.

The Treaty of Tlatelolco

[1] Argentina stated that it understands Article 18 as recognizing the right of parties to carry out, by their own means or in association with third parties, explosions of nuclear devices for peaceful purposes, including explosions which involve devices similar to those used in nuclear weapons.

[2] The Treaty is in force for this country due to a declaration, annexed to the instrument of ratification in accor-dance with Article 28, paragraph 2, which waived the requirements specified in paragraph 1 of that Article: namely that all states in the region deposit the instruments of ratification; that Additional Protocol I and Additiona Protocol II be signed and ratified by those states to which they apply; and that agreements on safeguards be con-cluded with the IAEA. Colombia made this declaration subsequent to the deposit of ratification (on 6 Septembe 1972), as did Nicaragua (on 24 October 1968) and Trinidad and Tobago (on 27 June 1975).

[3] On signing the Treaty, Brazil stated that, according to its interpretation, Article 18 of the Treaty gives the signa-tories the right to carry out, by their own means or in association with third parties, nuclear explosions for peacefu purposes, including explosions which involve devices similar to those used in nuclear weapons.

[4] Brazil stated that it did not waive the requirements laid down in Article 28 of the Treaty. The Treaty is therefore not yet in force for Brazil. In ratifying the Treaty, Brazil reiterated its interpretation of Article 18, which it made upon signing.

[5] Chile has not waived the requirements laid down in Article 28 of the Treaty. The Treaty is therefore not yet in force for Chile.

[6] On signing Protocol II, China stated, *inter alia*: "China will never use or threaten to use nuclear weapons against non-nuclear Latin American countries and the Latin American nuclear-weapon-free zone; nor will China test, manufacture, produce, stockpile, install or deploy nuclear weapons in these countries or in this zone, or send her means of transportation and delivery carrying nuclear weapons to cross the territory, territorial sea or airspace of Latin American countries. It is necessary to point out that the signing of Additional Protocol II to the Treaty for the Prohibition of Nuclear Weapons in Latin America by the Chinese Government does not imply any change whatsoever in China's principled stand on the disarmament and nuclear weapons issue and, in particular, does not affect the Chinese Government's consistent stand against the treaty on non-proliferation of nuclear weapons and the partial nuclear test ban treaty ..."

"The Chinese Government holds that, in order that Latin America may truly become a nuclear-weapon-free zone, all nuclear countries, and particularly the super-powers, which possess huge numbers of nuclear weapons must first of all undertake earnestly not to use or threaten to use nuclear weapons against the Latin American countries and the Latin American nuclear-weapon-free zone, and they must be asked to undertake to observe and implement the following: (1) dismantling of all foreign military bases in Latin America and refraining from estab-lishing any new foreign military bases there; (2) prohibition of the passage of any means of transportation and delivery carrying nuclear weapons through Latin American territory, territorial sea or air space."

[7] On signing Protocol II, France stated that it interprets the undertaking contained in Article 3 of the Protocol to mean that it presents no obstacle to the full exercise of the right of self-defence enshrined in Article 51 of the United Nations Charter; it takes note of the interpretation of the Treaty given by the Preparatory Commission and repro-duced in the Final Act, according to which the Treaty does not apply to transit, the granting or denying of which lies within the exclusive competence of each state party in accordance with the pertinent principles and rules of international law; it considers that the application of the legislation referred to in Article 3 of the Treaty relates to legislation which is consistent with international law. The provisions of Articles 1 and 2 of the Protocol apply to the text of the Treaty of Tlatelolco as it stands at the time when the Protocol is signed by France. Consequently, no amendment to the Treaty that might come into force under the provision of Article 29 thereof would be binding on the government of France without the latter's express consent. If this declaration of interpretation is contested in part or in whole by one or more contracting parties to the Treaty or to Protocol II, these instruments would be null and void as far as relations between the French Republic and the contesting state or states are concerned. On depositing its instrument of ratification of Protocol II, France stated that it did so subject to the statement made on signing the Protocol. On 15 April 1974, France made a supplementary statement to the effect that it was prepared to consider its obligations under Protocol II as applying not only to the signatories of the Treaty, but also to the territories for which the statute of denuclearization was in force in conformity with Article 1 of Protocol I.

[8] On signing the Treaty, Mexico said that if technological progress makes it possible to differentiate between nuclear weapons and nuclear devices for peaceful purposes, it will be necessary to amend the relevant provisions of the Treaty, according to the procedure established therein.

[9] The Netherlands stated that Protocol I shall not be interpreted as prejudicing the position of the Netherlands as regards its recognition or non-recognition of the rights of or claims to sovereignty of the parties to the Treaty, or of the grounds on which such claims are made. With respect to nuclear explosions for peaceful purposes on the terri-tory of Suriname and the Netherlands Antilles, no other rules apply than those operative for the parties to the Treaty. Upon Suriname's accession to independence on 25 November 1975, the obligations of the Netherlands under the Protocol apply only to the Netherlands Antilles.

[10] Nicaragua stated that it reserved the right to use nuclear energy for peaceful purposes such as the removal of earth for the construction of canals, irrigation works, power plants, and so on, as well as to allow the transit of atomic material through its territory.

[11] The Soviet Union signed and ratified Additional Protocol II with the following statement:

The Soviet Union proceeds from the assumption that the effect of Article 1 of the Treaty extends, as specified in Article 5 of the Treaty, to any nuclear explosive device and that, accordingly, the carrying out by any party to the Treaty of explosions of nuclear devices for peaceful purposes would be a violation of its obligations under Article 1 and would be incompatible with its non-nuclear status. For states parties to the Treaty, a solution to the problem of peaceful nuclear explosions can be found in accordance with the provisions of Article V of the NPT and within the framework of the international procedures of the IAEA. The signing of the Protocol by the Soviet Union does not in any way signify recognition of the possibility of the force of the Treaty as provided in Article 4(2) being extended beyond the territories of the states parties to the Treaty, including airspace and territorial waters as defined in accordance with international law. With regard to the reference in Article 3 of the Treaty to "its own legislation" in connection with the territorial waters, airspace and any other space over which the states parties o the Treaty exercise sovereignty, the signing of the Protocol by the Soviet Union does not signify recognition ıf their claims to the exercise of sovereignty which are contrary to generally accepted standards of international aw. The Soviet Union takes note of the interpretation of the Treaty given in the Final Act of the Preparatory Commission for the Denuclearization of Latin America to the effect that the transport of nuclear weapons by the ıarties to the Treaty is covered by the prohibitions envisaged in Article 1 of the Treaty. The Soviet Union reaffirms ts position that authorizing the transit of nuclear weapons in any form would be contrary to the objectives of the Treaty, according to which, as specially mentioned in the preamble, Latin America must be completely free from ıuclear weapons, and that it would be incompatible with the non-nuclear status of the states parties to the Treaty .nd with their obligations as laid down in Article 1 thereof.

Any actions undertaken by a state or states parties to the Tlatelolco Treaty which are not compatible with their ıon-nuclear status, and also the commission by one or more states parties to the Treaty of an act of aggression vith the support of a state which is in possession of nuclear weapons or together with such a state, will be regarded ›y the Soviet Union as incompatible with the obligations of those countries under the Treaty. In such cases the Soviet Union reserves the right to reconsider its obligations under Protocol II. It further reserves the right to econsider its attitude to this Protocol in the event of any actions on the part of other states possessing nuclear veapons which are incompatible with their obligations under the said Protocol. The provisions of the articles of Protocol II are applicable to the text of the Treaty for the Prohibition of Nuclear Weapons in Latin America in the vording of the Treaty at the time of the signing of the Protocol by the Soviet Union, due account being taken of he position of the Soviet Union as set out in the present statement. Any amendment to the Treaty entering into orce in accordance with the provisions of Articles 29 and 6 of the Treaty without the clearly expressed approval ıf the Soviet Union shall have no force as far as the Soviet Union is concerned.

In addition, the Soviet Union proceeds from the assumption that the obligations under Protocol II also apply o the territories for which the status of the denuclearized zone is in force in conformity with Protocol I of the Treaty.

[2] When signing and ratifying Additional Protocol I and Additional Protocol II, the United Kingdom made the ollowing declarations of understanding:

In connection with Article 3 of the Treaty, defining the term "territory" as including the territorial sea, airspace ınd any other space over which the state exercises sovereignty in accordance with "its own legislation", the UK loes not regard its signing or ratification of the Additional Protocols as implying recognition of any legislation vhich does not, in its view, comply with the relevant rules of international law.

The Treaty does not permit the parties to carry out explosions of nuclear devices for peaceful purposes unless ınd until advances in technology have made possible the development of devices for such explosions which are not :apable of being used for weapon purposes.

The signing and ratification by the UK could not be regarded as affecting in any way the legal status of any erritory for the international relations of which the UK is responsible, lying within the limits of the geographical :one established by the Treaty.

Should a party to the Treaty carry out any act of aggression with the support of a nuclear weapon state, the UK vould be free to reconsider the extent to which it could be regarded as committed by the provisions of Additional Protocol II.

In addition, the UK declared that its undertaking under Article 3 of Additional Protocol II not to use or threaten o use nuclear weapons against the parties to the Treaty extends also to territories in respect of which the under-aking under Article 1 of Additional Protocol I becomes effective.

[3] The United States signed and ratified Additional Protocol II with the following declarations of understanding:

In connection with Article 3 of the Treaty, defining the term "territory" as including the territorial sea, airspace ınd any other space over which the state exercises sovereignty in accordance with "its own legislation", the US atification of the Protocol could not be regarded as implying recognition of any legislation which did not, in its view, comply with the relevant rules of international law.

Each of the parties retains exclusive power and legal competence, unaffected by the terms of the Treaty, to grant or deny non-parties transit and transport privileges.

As regards the undertaking not to use or threaten to use nuclear weapons against the parties, the United States vould consider that an armed attack by a party, in which it was assisted by a nuclear weapon state, would be ncompatible with the party's obligations under Article 1 of the Treaty.

The definition contained in Article 5 of the Treaty is understood as encompassing all nuclear explosive devices; Articles 1 and 5 of the Treaty restrict accordingly the activities of the parties under paragraph 1 of Article 18.

Article 18, paragraph 4 permits, and US adherence to Protocol II will not prevent, collaboration by the USA vith the parties to the Treaty for the purpose of carrying out explosions of nuclear devices for peaceful purposes in ı manner consistent with a policy of not contributing to the proliferation of nuclear weapon capabilities.

The United States will act with respect to such territories of Protocol I adherents, as are within the geographical ırea defined in Article 4, paragraph 2 of the Treaty, in the same manner as Protocol II requires it to act with respect o the territories of the parties.

[4] Venezuela stated that in view of the existing controversy between Venezuela on the one hand and the United Kingdom and Guyana on the other, Article 25, paragraph 2 of the Treaty should apply to Guyana. This paragraph provides that no political entity should be admitted, part or all of whose territory is the subject of a dispute or claim between an extra-continental country and one or more Latin American states, so long as the dispute has not been settled by peaceful means.

[5] Safeguards under the NPT cover the Treaty of Tlatelolco.

The Non-Proliferation Treaty

On signing the Treaty, Australia stated, *inter alia*, that it regarded it as essential that the Treaty should not affect security commitments under existing treaties of mutual security.

[2] Notification of succession.

[3] On 25 November 1969, the United States notified its non-acceptance of notification of signature and ratification by the German Democratic Republic which it then did not recognize as a state. On 4 September 1974, the two countries established diplomatic relations with each other.

[4] On depositing the instrument of ratification, the Federal Republic of Germany reiterated the declaration made at the time of signing: it reaffirmed its expectation that the nuclear weapon states would intensify their efforts in accordance with the undertakings under Article VI of the Treaty, as well as its understanding that the security of FR Germany continued to be ensured by NATO; it stated that no provision of the Treaty may be interpreted in such a way as to hamper further development of European unification; that research, development and use of nuclear energy for peaceful purposes, as well as international and multinational co-operation in this field, must not be prejudiced by the Treaty; that the application of the Treaty, including the implementation of safeguards, must not lead to discrimination of the nuclear industry of FR Germany in international competition; and that it attached vital importance to the undertaking given by the United States and the United Kingdom concerning the application of safeguards to their peaceful nuclear facilities, hoping that other nuclear weapon states would assume similar obligations.

In a separate note, FR Germany declared that the Treaty will also apply to Berlin (West) without affecting Allied rights and responsibilities, including those relating to demilitarization. In notes of 24 July, 19 August, and 25 November 1975, respectively, addressed to the US Department of State, Czechoslovakia, the USSR and the German Democratic Republic stated that this declaration by FR Germany had no legal effect.

[5] On acceding to the Treaty, the Holy See stated, *inter alia*, that the Treaty will attain in full the objectives of security and peace and justify the limitations to which the states party to the Treaty submit, only if it is fully executed in every clause and with all its implications. This concerns not only the obligations to be applied immediately but also those which envisage a process of ulterior commitments. Among the latter, the Holy See considers it suitable to point out the following:

(*a*) The adoption of appropriate measures to ensure, on a basis of equality, that all non-nuclear weapon states party to the Treaty will have available to them the benefits deriving from peaceful applications of nuclear technology.

(*b*) The pursuit of negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

[6] On signing the Treaty, Indonesia stated, *inter alia*, that the government of Indonesia attaches great importance to the declarations of the USA, the UK and the USSR affirming their intention to provide immediate assistance to any non-nuclear weapon state party to the Treaty that is a victim of an act of aggression in which nuclear weapons are used.

Of utmost importance, however, is not the action *after* a nuclear attack has been committed but the guarantees to prevent such an attack. The Indonesian government trusts that the nuclear weapon states will study further this question of effective measures to ensure the security of the non-nuclear weapon states. Its decision to sign the Treaty is not to be taken in any way as a decision to ratify the Treaty. The ratification will be considered after matters of national security, which are of deep concern to the government and people of Indonesia, have been clarified to their satisfaction.

[7] Italy stated that in its belief nothing in the Treaty was an obstacle to the unification of the countries of Western Europe; it noted full compatibility of the Treaty with the existing security agreements; it noted further that when technological progress would allow the development of peaceful explosive devices different from nuclear weapons the prohibition relating to their manufacture and use shall no longer apply; it interpreted the provisions of Article IX, paragraph 3 of the Treaty, concerning the definition of a military nuclear state, in the sense that it referred exclusively to the five countries which had manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967, and stressed that under no circumstance would a claim of pertaining to such category be recognized by the Italian government to any other state.

[8] On depositing the instrument of ratification, Japan expressed the hope that France and China would accede to the Treaty; it urged a reduction of nuclear armaments and a comprehensive ban on nuclear testing; appealed to all states to refrain from the threat or use of force involving either nuclear or non-nuclear weapons; expressed the view that peaceful nuclear activities in non-nuclear weapon states party to the Treaty should not be hampered and that Japan should not be discriminated against in favour of other parties in any aspect of such activities. It also urged all nuclear weapon states to accept IAEA safeguards on their peaceful nuclear activities.

[9] A statement was made containing a disclaimer regarding the recognition of states party to the Treaty.

[10] On depositing the instrument of ratification, the Republic of Korea took note of the fact that the depositary governments of the three nuclear weapon states had made declarations in June 1968 to take immediate and effective measures to safeguard any non-nuclear weapon state which is a victim of an act or an object of a threat of aggression in which nuclear weapons are used. It recalled that the UN Security Council adopted a resolution to the same effect on 19 June 1968.

[11] On signing the Treaty, Mexico stated, *inter alia*, that none of the provisions of the Treaty shall be interpreted as affecting in any way whatsoever the rights and obligations of Mexico as a state party to the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco).

It is the understanding of Mexico that at the present time any nuclear explosive device is capable of being used as a nuclear weapon and that there is no indication that in the near future it will be possible to manufacture nuclear explosive devices that are not potentially nuclear weapons. However, if technological advances modify this situation, it will be necessary to amend the relevant provisions of the Treaty in accordance with the procedure established therein.

[12] On depositing the instruments of ratification and accession, Switzerland and Liechtenstein stated that activitie

ot prohibited under Articles I and II of the Treaty include, in particular, the whole field of energy production nd related operations, research and technology concerning future generations of nuclear reactors based on fission r fusion, as well as production of isotopes. Switzerland and Liechtenstein define the term "source or special ssionable material" in Article III of the Treaty as being in accordance with Article XX of the IAEA Statute, and a ıodification of this interpretation requires their formal consent; they will accept only such interpretations and efinitions of the terms "equipment or material especially designed or prepared for the processing, use or production of special fissionable material", as mentioned in Article III of the Treaty, that they will expressly approve; nd they understand that the application of the Treaty, especially of the control measures, will not lead to discrimiation of their industry in international competition.

The United Kingdom recalled its view that if a régime is not recognized as the government of a state, neither gnature nor the deposit of any instrument by it, nor notification of any of those acts, will bring about recognition f that régime by any other state. The provisions of the Treaty shall not apply with regard to Southern Rhodesia nless and until the government of the United Kingdom informs the other depositary governments that it is in a osition to ensure that the obligations imposed by the Treaty in respect of that territory can be fully implemented. 'ameroon stated that it was unable to accept the reservation concerning Southern Rhodesia. Also Mongolia :ated that the obligations assumed by the United Kingdom under the Non-Proliferation Treaty should apply qually to Southern Rhodesia. In a note addressed to the British Embassy in Moscow, the Soviet government ĸpressed the view that the United Kingdom carries the entire responsibility for Southern Rhodesia until the eople of that territory acquire genuine independence, and that this fully applies to the Non-Proliferation Treaty.

This agreement, signed between the United Kingdom, Euratom and the IAEA, provides for the submission of ritish non-military nuclear installations to safeguards under IAEA supervision.

This agreement, under which US civilian nuclear facilities will be placed under IAEA safeguards, was approved y the IAEA Board but was not in force by 31 December 1978.

In connection with the ratification of the Treaty, Yugoslavia stated, *inter alia*, that it considered a ban on the evelopment, manufacture and use of nuclear weapons and the destruction of all stockpiles of these weapons to e indispensable for the maintenance of a stable peace and international security; it held the view that the chief esponsibility for progress in this direction rested with the nuclear weapon powers, and expected these powers to ndertake not to use nuclear weapons against the countries which have renounced them as well as against nonuclear weapon states in general, and to refrain from the threat to use them. It also emphasized the significance it ttached to the universality of the efforts relating to the realization of the NPT.

'he Sea-Bed Treaty

On signing the Treaty, Argentina stated that it interprets the references to the freedom of the high seas as in no 'ay implying a pronouncement of judgement on the different positions relating to questions connected with ıternational maritime law. It understands that the reference to the rights of exploration and exploitation by coastal :ates over their continental shelves was included solely because those could be the rights most frequently affected y verification procedures. Argentina precludes any possibility of strengthening, through this Treaty, certain ositions concerning continental shelves to the detriment of others based on different criteria.

On signing the Treaty, Brazil stated that nothing in the Treaty shall be interpreted as prejudicing in any way the overeign rights of Brazil in the area of the sea, the sea-bed and the subsoil thereof adjacent to its coasts. It is the nderstanding of the Brazilian government that the word "observation", as it appears in paragraph 1 of Article III f the Treaty, refers only to observation that is incidental to the normal course of navigation in accordance with ıternational law.

In depositing the instrument of ratification Canada declared: Article I, paragraph 1 cannot be interpreted as ıdicating that any state has a right to implant or emplace any weapons not prohibited under Article I, paragraph 1 n the sea-bed and ocean floor, and in the subsoil thereof, beyond the limits of national jurisdiction, or as constituting ny limitation on the principle that this area of the sea-bed and ocean floor and the subsoil thereof shall be reserved or exclusively peaceful purposes. Articles I, II and III cannot be interpreted as indicating that any state but the oastal state has any right to implant or emplace any weapon not prohibited under Article I, paragraph 1 on the ontinental shelf, or the subsoil thereof, appertaining to that coastal state, beyond the outer limit of the sea-bed one referred to in Article I and defined in Article II. Article III cannot be interpreted as indicating any restrictions r limitation upon the rights of the coastal state, consistent with its exclusive sovereign rights with respect to the ontinental shelf, to verify, inspect or effect the removal of any weapon, structure, installation, facility or device nplanted or emplaced on the continental shelf, or the subsoil thereof, appertaining to that coastal state, beyond ıe outer limit of the sea-bed zone referred to in Article I and defined in Article II. On 12 April 1976, the Federal epublic of Germany stated that the declaration by Canada is not of a nature to confer on the government of this ountry more far-reaching rights than those to which it is entitled under current international law, and that all ghts existing under current international law which are not covered by the prohibitions are left intact by the 'reaty.

A statement was made containing a disclaimer regarding recognition of states party to the Treaty.

On ratifying the Treaty, the Federal Republic of Germany declared that the Treaty will apply to Berlin (West).

On the occasion of its accession to the Treaty, the government of India stated that as a coastal state, India has, nd always has had, full and exclusive sovereign rights over the continental shelf adjoining its territory and beyond s territorial waters and the subsoil thereof. It is the considered view of India that other countries cannot use its ontinental shelf for military purposes. There cannot, therefore, be any restriction on, or limitation of, the sovereign ght of India as a coastal state to verify, inspect, remove or destroy any weapon, device, structure, installation or ıcility, which might be implanted or emplaced on or beneath its continental shelf by any other country, or to take ıch other steps as may be considered necessary to safeguard its security. The accession by the government of ıdia to the Sea-Bed Treaty is based on this position. In response to the Indian statement, the US government ĸpressed the view that, under existing international law, the rights of coastal states over their continental shelves are exclusive only for purposes of exploration and exploitation of natural resources, and are otherwise limited t the 1958 Convention on the Continental Shelf and other principles of international law. On 12 April 1976, tl Federal Republic of Germany stated that the declaration by India is not of a nature to confer on the governme of this country more far-reaching rights than those to which it is entitled under current international law, and th all rights existing under current international law which are not covered by the prohibitions are left intact by tl Treaty.

[7] On signing the Treaty, Italy stated, *inter alia*, that in the case of agreements on further measures in the field disarmament to prevent an arms race on the sea-bed and ocean floor and in their subsoil, the question of tl delimitation of the area within which these measures would find application shall have to be examined and solved each instance in accordance with the nature of the measures to be adopted. The statement was repeated at the tir of ratification.

[8] Romania stated that it considered null and void the ratification of the Treaty by the Taiwan authorities.

[9] The United Kingdom recalled its view that if a régime is not recognized as the government of a state, neith signature nor the deposit of any instrument by it, nor notification of any of those acts, will bring about recognitic of that régime by any other state.

[10] On 25 February 1974, the Ambassador of Yugoslavia transmitted to the US Secretary of State a note stating th in the view of the Yugoslav government, Article III, paragraph 1 of the Treaty should be interpreted in such way that a state exercising its right under this Article shall be obliged to notify in advance the coastal state, in so f as its observations are to be carried out "within the stretch of the sea extending above the continental shelf of tl said state". On 16 January 1975, the US Secretary of State presented the view of the USA concerning the Yugosl note, as follows: "Insofar as the note is intended to be interpretative of the Treaty, the United States cann accept it as a valid interpretation. In addition, the United States does not consider that it can have any effect on tl existing law of the sea". In so far as the note was intended to be a reservation to the Treaty, the United Stat placed on record its formal objection to it on the grounds that it was incompatible with the object and purpose of tl Treaty. The United States also drew attention to the fact that the note was submitted too late to be legally effecti as a reservation. A similar exchange of notes took place between Yugoslavia and the United Kingdom. On 12 Ap 1976, the Federal Republic of Germany stated that the declaration by Yugoslavia is not of a nature to confer c the government of this country more far-reaching rights than those to which it is entitled under current internation law, and that all rights existing under current international law which are not covered by the prohibitions are le intact by the Treaty.

The BW Convention

[1] Considering the obligations resulting from its status as a permanently neutral state, Austria declares a reservatic to the effect that its co-operation within the framework of this Convention cannot exceed the limits determined t the status of permanent neutrality and membership with the United Nations.

[2] In a statement made on the occasion of the signature of the Convention, India reiterated its understanding that tl objective of the Convention is to eliminate biological and toxin weapons, thereby excluding completely the pos bility of their use, and that the exemption in regard to biological agents or toxins, which would be permitted f prophylactic, protective or other peaceful purposes, would not in any way create a loophole in regard to tl production or retention of biological and toxin weapons. Also any assistance which might be furnished under tl terms of the Convention would be of a medical or humanitarian nature and in conformity with the Charter the United Nations. The statement was repeated at the time of the deposit of the instrument of ratification.

[3] Ireland considers that the Convention could be undermined if reservations made by the parties to the 19 Geneva Protocol were allowed to stand, as the prohibition of possession is incompatible with the right to retalia and that there should be an absolute and universal prohibition of the use of the weapons in question. Irelar notified the depositary government for the Geneva Protocol of the withdrawal of its reservations to the Protoc made at the time of accession in 1930. The withdrawal applies to chemical as well as to bacteriological (biologic and toxin agents of warfare.

[4] The Republic of Korea stated that the signing of the Convention does not in any way mean or imply the recogr tion of any territory or régime which has not been recognized by the Republic of Korea as a state or governme

[5] In the understanding of Kuwait, its ratification of the Convention does not in any way imply its recognition Israel, nor does it oblige it to apply the provisions of the Convention in respect of the said country.

[6] Mexico considers that the Convention is only a first step towards an agreement prohibiting also the developme production and stockpiling of all chemical weapons, and notes the fact that the Convention contains an expre commitment to continue negotiations in good faith with the aim of arriving at such an agreement.

[7] The ratification by Switzerland contains the following reservations:

1. Owing to the fact that the Convention also applies to weapons, equipment or means of delivery designed to u biological agents or toxins, the delimitation of its scope of application can cause difficulties since there are scarce any weapons, equipment or means of delivery peculiar to such use; therefore, Switzerland reserves the right decide for itself what auxiliary means fall within that definition.

2. By reason of the obligations resulting from its status as a perpetually neutral state, Switzerland is bound make the general reservation that its collaboration within the framework of this Convention cannot go beyond tl terms prescribed by that status. This reservation refers especially to Article VII of the Convention as well as to a similar clause that could replace or supplement that provision of the Convention (or any other arrangement).

In a note of 18 August 1976, addressed to the Swiss Ambassador, the US Secretary of State stated the followi view of the US government with regard to the first reservation: The prohibition would apply only to (*a*) weapor equipment and means of delivery, the design of which indicated that they could have no other use than that specifie and (*b*) weapons, equipment and means of delivery, the design of which indicated that they were specifically intend to be capable of the use specified. The government of the United States shares the view of the government witzerland that there are few weapons, equipment or means of delivery peculiar to the uses referred to. It does not, owever, believe that it would be appropriate, on this ground alone, for states to reserve unilaterally the right to ecide which weapons, equipment or means of delivery fell within the definition. Therefore, while acknowledging ne entry into force of the Convention between itself and the government of Switzerland, the United States government enters its objection to this reservation.

The USSR stated that it considered the deposit of the instrument of ratification by Taiwan as an illegal act ecause the government of the Chinese People's Republic is the sole representative of China.

The United Kingdom recalled its view that if a régime is not recognized as the government of a state, neither ignature nor the deposit of any instrument by it, nor notification of any of those acts will bring about recognition f that régime by any other state. It declared that the provisions of the Convention shall not apply in regard to outhern Rhodesia unless and until the British government informs the other depositary governments that it is in a osition to ensure that the obligations imposed by the Convention in respect of that territory can be fully implemented. In a note addressed to the British Embassy in Moscow, the Soviet government expressed the view that he United Kingdom carries the entire responsibility for Southern Rhodesia until the people of that territory cquire genuine independence, and that this fully applies to the BW Convention.

'he ENMOD Convention

On signing the Convention, Turkey declared that the terms "widespread", "long-lasting" and "severe effects" ontained in the Convention need to be more clearly defined, and that so long as this clarification was not made, 'urkey would be compelled to interpret itself the terms in question and, consequently, reserved the right to do so s and when required. Turkey also stated its belief that the difference between "military or any other hostile purposes" and "peaceful purposes" should be more clearly defined so as to prevent subjective evaluations.

14. The humanitarian rules of war

I. Attempts to 'humanize' war

Efforts to reduce brutality in war have a long history. They have been motivated by ethical and religious as well as practical considerations. Of special significance was the Declaration of St Petersburg of 1868. It proclaimed that the only legitimate objective which states should endeavour to accomplish during war is to weaken the military forces of the enemy, and that the employment of arms which uselessly aggravate the suffering of disabled men, or render their death inevitable, would be contrary to the laws of humanity.

Following the spirit of the St Petersburg Declaration, Declaration IV,3 of the 1899 Hague Conference prohibited the use of so-called dumdum bullets, which expanded or flattened easily in the human body and caused more serious wounds than other bullets.

The Second Hague Conference, held in 1907, adopted Convention IV on laws and customs of land warfare, which confirmed the principles of the St Petersburg Declaration. It stated that the right of belligerents to adopt means of injuring the enemy is not unlimited, and it prohibited the employment of arms, projectiles or material calculated to cause unnecessary suffering. In particular, the Convention prohibited the use of poison or poisoned weapons, the treacherous killing or wounding of individuals belonging to the hostile nation or army, or the killing or wounding of an enemy who had laid down his arms or surrendered. The same conference restricted and regulated, in Convention VIII, the use of automatic submarine contact mines; prohibited, in Convention IX, the bombardment by naval forces of ports, cities, villages, habitations or buildings which were not defended; and proclaimed, in Declaration XIV, a prohibition on the discharge of projectiles and explosives from balloons or by other methods of a similar nature.

The two Hague Conferences brought advances in codifying the laws of war on a world-wide scale. Plans for a third conference had to be abandoned in view of the intensified inter-state antagonisms that preceded World War I.

After the war, on 17 June 1925, the Geneva Protocol was signed, prohibiting the use of asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices, as well as the use of bacteriological methods of warfare. In the part dealing with gases, the Protocol actually ratified a prohibition previously declared in international documents. These included the 1899 Hague Declaration IV,2, under which the contracting powers had agreed to abstain from the use of projectiles for the diffusion of asphyxiating or deleterious gases, as well as the 1907 Hague Convention IV, mentioned above. The need to restate the prohibition of acts already held in abhorrence and condemned by world opinion was prompted by the experience of World War I, during which the extensive use of poisonous gas resulted in as many as 1 300 000 casualties.

When World War II broke out, the following agreements for the protection of war victims were in force: the Convention for the amelioration of the condition of the wounded and sick in armies in the field (which replaced the Red Cross Conventions of 22 August 1864 and 6 July 1906) and the Convention relative to the treatment of prisoners of war, both of which were signed on 27 July 1929. But none of the existing international instruments proved sufficient in providing humanitarian safeguards during World War II. Indeed, the shock of the discovery of mass crimes committed during that war led to the 1948 Convention on the prevention and punishment of the crime of genocide —the so-called Genocide Convention. This Convention declares genocide, defined as the commission of acts intended to destroy, in whole or in part, a national, ethnical, racial or religious group, as such, to be a crime to be prevented and punished. Further rules were worked out at a conference held in Geneva in 1949, and were included in the following four conventions: Convention (I) for the amelioration of the condition of the wounded and sick in armed forces in the field; Convention (II) for the amelioration of the condition of the wounded, sick and shipwrecked members of armed forces at sea; Convention (III) relative to the treatment of prisoners of war; and Convention (IV) relative to the protection of civilian persons in time of war.

The Geneva Conventions of 1949 were conceived primarily as a code of behaviour in wars of the traditional type, conducted between states and between regular armies. However, since World War II, most armed conflicts have been civil wars. Guerrilla warfare has been the prevalent type of such conflicts and has complicated the application of the principle that a distinction must be observed between the civilian and the military. As a result, the protection of civilians has weakened considerably. Furthermore, the laws of war which relate directly to the conduct of hostilities by banning or restricting the use of a specific weapon or type of weapon, as distinct from rules designed to accord protection to certain persons, places or objects in armed conflicts, had not developed since the 1907 Hague Conventions, with the sole exception of the above-mentioned 1925 Geneva Protocol. In particular, air warfare had remained to a great extent uncodified; area bombardment, which caused the destruction of many cities in World War II, was not expressly forbidden, and weapons which had come into existence during the preceding decades and which were of an especially cruel or inhumane nature had not been specifically prohibited.

To deal with all these matters, a Diplomatic Conference on the reaffirmation and development of international law applicable in armed conflicts was convened in Geneva in 1974. In 1977, at the end of the fourth session of the Conference, two protocols were adopted: Protocol I, relating to the protection of victims of international armed conflicts; and Protocol II, relating to the protection of victims of non-international armed conflicts. Both were signed on 12 December 1977.

Protocol I reiterates the basic 'Hague rules', namely, that the right of the parties to an armed conflict to choose methods or means of warfare is not unlimited, and that it is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering (Article 35, paragraphs 1 and 2). In addition, the parties are under an obligation to determine in their study, development, acquisition or adoption of a new weapon, means or method of warfare, whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law (Article 36).

The Protocol also reiterates and expands the traditional rules regarding respect for and protection of the civilian population and civilian objects (Article 48). The prohibition against indiscriminate attacks now covers attacks by bombardment by any methods or means which treat as a single military objective a number of distinct objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects, as well as attacks expected to cause incidental losses or injuries to civilians, which would be excessive in relation to the direct military advantage anticipated (Article 51, paragraph 5). Reprisals against the civilian population are forbidden (Article 51, paragraph 6). It is furthermore prohibited to destroy foodstuffs, agricultural areas for the production of foodstuffs, crops, livestock, drinking water installations and supplies and irrigation works, for the specific purpose of denying the civilian population those objects which are indispensable for its survival (Article 54). Dams, dykes and nuclear electric power-generating stations have been placed under special protection, and shall not be attacked, if an attack on them may cause severe losses among civilians (Article 56). (This protection will, however, cease if the installations in question are used in significant and direct support of military operations and if an attack on them is the only feasible way to terminate such support.)

Detailed precautionary measures are prescribed to spare the civilian population and civilian objects in the conduct of military operations (Article 57). There is also a prohibition to attack, by any means, non-defended localities, declared as such by the appropriate authorities of a party (Article 59), or to extend military operations to zones on which the parties have conferred by agreement the status of demilitarized zone (Article 60).

A special provision is devoted to the protection of the natural environment against widespread, long-term and severe damage.[1] It includes a prohibition on the use of methods and means of warfare that are intended or may be expected to cause such damage to the natural environment and thereby to prejudice the health or survival of the population (Article 35, paragraph 3 and Article 55).

Protocol I is applicable not only to inter-state armed conflicts, but also to conflicts in which peoples are fighting against colonial domination and alien occupation and against racist régimes in the exercise of their right to self-determination (Article 1). In this way, guerrilla fighters have been covered by international protection. In particular, they have been given the right to prisoner-of-war status if they belong to organized units under a command responsible to the party concerned, and if they carry their arms openly during each military engagement, and during such time as they are visible to the adversary before launching an attack (Articles 43 and 44). On the other hand, mercenaries, as defined in the Protocol, have no right to combatant or prisoner-of-war status (Article 47).

Several articles dealing with relief actions in favour of the civilian population have strengthened the corresponding clauses of the 1949 Geneva Convention IV. The duties of the occupying power include the provision, to the fullest extent of the means available, of supplies essential to the survival of the civilian population of the occupied territory (Article 69).

A special section is devoted to repression of breaches of the Protocol, the establishment of an international fact-finding commission, and responsibility (Articles 85 to 91).

Protocol II develops and supplements Article 3, which appears in all the four Geneva Conventions of 1949, and which deals with armed conflicts not of an international character. It prescribes humane treatment of all the persons involved in such conflicts, care for the wounded, sick and shipwrecked, as well as protection of civilians against the dangers arising from military operations. It does not apply

[1] This formulation is more restricted than that included in the Environmental Modification Convention (see chapter 13) because it requires the presence of all three effects—widespread, long-term and severe—for the method and means of warfare to be prohibited.

to internal disturbances, such as riots, sporadic acts of violence and similar acts.

The two protocols of 1977 constitute a step forward in the development of the humanitarian laws of war, even though some of their provisions lack clarity and certain definitions are imprecise. Their greatest shortcoming, however, is that they have not prohibited any specific weapon which is excessively injurious or has indiscriminate effects. Nuclear or other weapons of mass destruction, which clearly fall under this category, were not even considered at the Geneva Diplomatic Conference. And, in signing Protocol I, the USA and the UK stated their understanding that the rules established therein were not intended to have any effect on and do not regulate or prohibit the use of nuclear weapons. The question of conventional weapons of a particularly cruel nature was discussed in detail, but has not been resolved. Further attempts to prohibit or restrict the use of certain conventional weapons which may be deemed to be excessively injurious or to have indiscriminate effects will be made at a special UN Conference in September 1979. (The weapons considered for such prohibitions or restrictions are dealt with in chapter 9.)

II. Parties to the 1925 Geneva Protocol, the 1949 Geneva Conventions, and Protocols I and II additional to the 1949 Geneva Conventions, as of 31 December 1978

Protocol for the prohibition of the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare (Geneva Protocol)

Signed at Geneva on 17 June 1925.

Entered into force on 8 February 1928. Thereafter, for each signatory state the Protocol comes into force as from the date of deposit of its instrument of ratification. Accession to the protocol takes effect on the date of the notification by the depositary government.

Depositary: French government.
Number of parties: 98.

Conventions for the protection of war victims (Geneva Conventions)

Convention (I) for the amelioration of the condition of the wounded and sick in armed forces in the field.
Convention (II) for the amelioration of the condition of the wounded, sick and shipwrecked members of armed forces at sea.
Convention (III) relative to the treatment of prisoners of war.

Convention (IV) relative to the protection of civilian persons in time of war.

Signed at Geneva on 12 August 1949.

Entered into force on 21 October 1950. Thereafter, for each party the Conventions come into force six months after the deposit of its instrument of ratification. Accessions take effect six months after the date on which they are received.

Depositary: Swiss Federal Council.

Number of parties: 145.

Protocols additional to the 1949 Geneva Conventions

Protocol (I) relating to the protection of victims of international armed conflicts.

Protocol (II) relating to the protection of victims of non-international armed conflicts.

Signed at Bern on 12 December 1977.

Entered into force on 7 December 1978. Thereafter, for each party to the 1949 Conventions, the Protocols enter into force six months after the deposit of its instrument of ratification or accession.

Depositary: Swiss Federal Council.

Number of parties: 3.

Note:

1. States which have signed but still not ratified are indicated by an S followed by the date of signature.
2. The date of succession given is that on which notification of succession was received by the depositary government.
3. The footnotes, including the reservations, are listed at the end of the table and are grouped under separate headings for: the Geneva Protocol, the 1949 Geneva Conventions, and the Protocols to the 1949 Geneva Conventions.

Country	1925 Geneva Protocol	1949 Geneva Conventions	Protocols to the 1949 Geneva Conventions
Afghanistan		26 Sep 1956	
Albania		27 May 1957[1]	
Algeria		20 Jun 1960	
Argentina	12 May 1969	18 Sep 1956	
Australia	24 May 1930[1]	14 Oct 1958	S: 7 Dec 1978[1]
Austria	9 May 1928	27 Aug 1953	S: 12 Dec 1977
Bahamas		11 Jul 1975[2]	
Bahrain		30 Nov 1971	
Bangladesh		4 Apr 1972[2]	
Barbados	16 Jul 1976[2]	10 Sep 1968[2]	
Belgium	4 Dec 1928[1]	3 Sep 1952	S: 12 Dec 1977
Benin		14 Dec 1961[2]	
Bolivia		10 Dec 1976	
Botswana		29 Mar 1968	
Brazil	28 Aug 1970	29 Jun 1957[3]	
Bulgaria	7 Mar 1934[1]	22 Jul 1954[1]	S: 11 Dec 1978
Burundi		27 Dec 1971[2]	
Byelorussia	[3]	3 Aug 1954[1]	S: 12 Dec 1977
Cambodia: *see* Democratic Kampuchea			
Cameroon: *see* United Republic of Cameroon			
Canada	6 May 1930[1]	14 May 1965	S: 12 Dec 1977[1]
Central African Empire	31 Jul 1970	1 Aug 1966[2]	
Chad		5 Aug 1970	
Chile	2 Jul 1935[1]	12 Oct 1950	S: 12 Dec 1977
China	24 Aug 1929[4]	28 Dec 1956[1]	
Colombia		8 Nov 1961	
Congo		30 Jan 1967[2]	
Costa Rica		15 Oct 1969	
Cuba	24 Jun 1966	15 Apr 1954	
Cyprus	29 Nov 1966[5]	23 May 1962	S: 12 Jul 1978 Prot. I
Czechoslovakia	16 Aug 1938[6]	19 Dec 1950[1]	S: 6 Dec 1978
Democratic Kampuchea (Cambodia)		8 Dec 1958	
Democratic Yemen*		25 May 1977	
Denmark	5 May 1930	27 Jun 1951	S: 12 Dec 1977
Djibouti		26 Jan 1978 Conv. I[2] 6 Mar 1978 Conv. II, III, IV[2]	

Country	1925 Geneva Protocol	1949 Geneva Conventions	Protocols to the 1949 Geneva Conventions
Dominican Republic	8 Dec 1970	22 Jan 1958	
Ecuador	16 Sep 1970	11 Aug 1954	S: 12 Dec 1977
Egypt	6 Dec 1928	10 Nov 1952	S: 12 Dec 1977
El Salvador	S: 17 Jun 1925	17 Jun 1953	23 Nov 1978
Ethiopia	20 Sep 1935[7]	2 Oct 1969	
Fiji	21 Mar 1973[8]	9 Aug 1971[2]	
Finland	26 Jun 1929	22 Feb 1955	S: 12 Dec 1977
France	10 May 1926[1]	28 Jun 1951	
Gabon		20 Feb 1965[2]	
Gambia	5 Nov 1966[9]	11 Oct 1966[2]	
German Democratic Republic	25 Apr 1929	30 Nov 1956[1]	S: 12 Dec 1977
Germany, Federal Republic of	25 Apr 1929	13 Sep 1954[4]	S: 23 Dec 1977[1]
Ghana	3 May 1967	2 Aug 1958	28 Feb 1978
Greece	30 May 1931	5 Jun 1956	S: 22 Mar 1978[1] Prot. I
Guatemala		14 May 1952	S: 12 Dec 1977
Guinea-Bissau		21 Feb 1974[5]	
Guyana		22 Jul 1968[2]	
Haiti		11 Apr 1957	
Holy See (Vatican City)	18 Oct 1966	22 Feb 1951	S: 12 Dec 1977
Honduras		31 Dec 1965	S: 12 Dec 1977
Hungary	11 Oct 1952	3 Aug 1954[6]	S: 12 Dec 1977
Iceland	2 Nov 1967	10 Aug 1965	S: 12 Dec 1977
India	9 Apr 1930[1]	9 Nov 1950	
Indonesia	21 Jan 1971[10]	30 Sep 1958	
Iran	5 Nov 1929	20 Feb 1957	S: 12 Dec 1977
Iraq	8 Sep 1931[1]	14 Feb 1956	
Ireland	29 Aug 1930[11]	27 Sep 1962	S: 12 Dec 1977
Israel	20 Feb 1969[12]	6 Jul 1951[7]	
Italy	3 Apr 1928	17 Dec 1951[8]	S: 12 Dec 1977[1]
Ivory Coast	27 Jul 1970	28 Dec 1961	S: 12 Dec 1977
Jamaica	28 Jul 1970[13]	17 Jul 1964[2]	
Japan	21 May 1970	21 Apr 1953	
Jordan	17 Mar 1977[14]	29 May 1951	S: 12 Dec 1977
Kampuchea: *see* Democratic Kampuchea			
Kenya	6 Jul 1970	20 Sep 1966	
Korea, North		27 Aug 1957[1]	
Korea, South		16 Aug 1966[9]	S: 7 Dec 1978
Kuwait	15 Dec 1971[15]	2 Sep 1967	
Lao People's Democratic Republic		29 Oct 1956	S: 18 Apr 1978
Lebanon	17 Apr 1969	10 Apr 1951	
Lesotho	10 Mar 1972[16]	20 May 1968[2]	
Liberia	17 Jun 1927	29 Mar 1954	
Libya	29 Dec 1971[17]	22 May 1956	7 Jun 1978
Liechtenstein		21 Sep 1950	S: 12 Dec 1977
Luxembourg	1 Sep 1936	1 Jul 1953	S: 12 Dec 1977
Madagascar	2 Aug 1967	13 Jul 1963[2]	S: 13 Oct 1978
Malawi	14 Sep 1970	5 Jan 1968	
Malaysia	10 Dec 1970	24 Aug 1962	
Maldives	27 Dec 1966[18]		
Mali		24 May 1965	

Country	1925 Geneva Protocol	1949 Geneva Conventions	Protocols to the 1949 Geneva Conventions
Malta	9 Oct 1970[19]	22 Aug 1968[2]	
Mauritania		27 Oct 1962[2]	
Mauritius	23 Dec 1970[20]	18 Aug 1970[2]	
Mexico	28 May 1932	29 Oct 1952	
Monaco	6 Jan 1967	5 Jul 1950	
Mongolia	6 Dec 1968[21]	20 Dec 1958	S: 12 Dec 1977
Morocco	13 Oct 1970	26 Jul 1956	S: 12 Dec 1977
Nepal	9 May 1969	7 Feb 1964	
Netherlands	31 Oct 1930[22]	3 Aug 1954[10]	S: 12 Dec 1977
New Zealand	24 May 1930[1]	2 May 1959[10]	S: 27 Nov 1978
Nicaragua	S: 17 Jun 1925	17 Dec 1953	S: 12 Dec 1977
Niger	5 Apr 1967[23]	16 Apr 1964[2]	S: 16 Jun 1978
Nigeria	15 Oct 1968[1]	9 Jun 1961[2]	
Norway	27 Jul 1932	3 Aug 1951	S: 12 Dec 1977
Oman		31 Jan 1974	
Pakistan	15 Apr 1960[24]	12 Jun 1951[11]	S: 12 Dec 1977
Panama	4 Dec 1970	10 Feb 1956	S: 12 Dec 1977
Papua New Guinea		26 May 1976[2]	
Paraguay	22 Oct 1933[25]	23 Oct 1961	
Peru		15 Feb 1956	S: 12 Dec 1977
Philippines	8 Jun 1973	7 Mar 1951 Conv. I 6 Oct 1952 Conv. II, III, IV	S: 12 Dec 1977 Prot. I
Poland	4 Feb 1929	26 Nov 1954[1]	S: 12 Dec 1977
Portugal	1 Jul 1930[1]	14 Mar 1961[12]	S: 12 Dec 1977[1]
Qatar	18 Oct 1976	15 Oct 1975	
Romania	23 Aug 1929[1]	1 Jun 1954[1]	S: 28 Mar 1978
Rwanda	11 May 1964[26]	21 Mar 1964[2]	
San Marino		29 Aug 1953	S: 22 Jun 1978
Sao Tome and Principe		21 May 1976	
Saudi Arabia	27 Jan 1971	18 May 1963	
Senegal	20 Jul 1977	23 Apr 1963[2]	S: 12 Dec 1977
Sierra Leone	20 Mar 1967	31 May 1965[2]	
Singapore		27 Apr 1973	
Somalia		12 Jul 1962	
South Africa	24 May 1930[1]	31 Mar 1952	
Spain	22 Aug 1929[27]	4 Aug 1952[13]	S: 7 Nov 1978[1]
Sri Lanka	20 Jan 1954	28 Feb 1959 Conv. I, II, III 23 Feb 1959 Conv. IV	
Sudan		23 Sep 1957	
Suriname	[28]	13 Oct 1976[2]	
Swaziland		28 Jun 1973	
Sweden	25 Apr 1930	28 Dec 1953	S: 12 Dec 1977
Switzerland	12 Jul 1932	31 Mar 1950	S: 12 Dec 1977[2]
Syria	17 Dec 1968[29]	2 Nov 1953	
Tanzania: *see* United Republic of Tanzania			
Thailand	6 Jun 1931	29 Dec 1954	
Togo	5 Apr 1971	6 Jan 1962[2]	S: 12 Dec 1977
Tonga	28 Jul 1971	13 Apr 1978[2]	
Trinidad and Tobago	24 Nov 1970[30]	17 May 1963 Conv. I 24 Sep 1963 Conv. II, III, IV	

Country	1925 Geneva Protocol	1949 Geneva Conventions	Protocols to the 1949 Geneva Conventions
Tunisia	12 Jul 1967	4 May 1957	S: 12 Dec 1977
Turkey	5 Oct 1929	10 Feb 1954	
Uganda	24 May 1965	18 May 1964	
Ukraine		3 Aug 1954[1]	S: 12 Dec 1977
Union of Soviet Socialist Republics	15 Apr 1928[31]	10 May 1954[1]	S: 12 Dec 1977
United Arab Emirates		10 May 1972	
United Kingdom	9 Apr 1930[1]	23 Sep 1957	S: 12 Dec 1977[3]
United Republic of Cameroon		16 Sep 1963[2]	
United Republic of Tanzania	22 Apr 1963	12 Dec 1962[2]	
United States	10 Apr 1975[32]	2 Aug 1955[14]	S: 12 Dec 1977[4]
Upper Volta	3 Mar 1971	7 Nov 1961[2]	S: 11 Jan 1978
Uruguay	12 Apr 1977	5 Mar 1969[15]	
Venezuela	8 Feb 1928	13 Feb 1956	
Viet Nam		28 Jun 1957[1]	S: 12 Dec 1977 Prot. I
Yemen*	17 Mar 1971	16 Jul 1970	S: 14 Feb 1978
Yugoslavia	12 Apr 1929[33]	21 Apr 1950[16]	S: 12 Dec 1977
Zaire		20 Feb 1961[2]	
Zambia		19 Oct 1966	

*'Democratic Yemen' refers to the People's Democratic Republic of Yemen (Southern Yemen). 'Yemen' refers to the Yemen Arab Republic (Northern Yemen).

The 1925 Geneva Protocol

[1] The Protocol is binding on this state only as regards states which have signed and ratified or acceded to it. The Protocol will cease to be binding on this state in regard to any enemy state whose armed forces or whose allies fail to respect the prohibitions laid down in the Protocol. (These reservations were made in similar terms by *Australia, Belgium, Bulgaria, Canada, Chile, France, India, Iraq, New Zealand, Nigeria, Portugal, Romania, South Africa* and *the United Kingdom.)*

[2] In a note of 22 June 1976, addressed to the depositary government, *Barbados* declared that it considered the Protocol to be in force in respect of Barbados in virtue of its extension to it by the United Kingdom. It further declared that as far as Barbados was concerned the reservation made on 9 April 1930 by the British Empire was withdrawn.

[3] On 2 March 1970 *Byelorussia* stated that "it recognizes itself to be a party" to the Geneva Protocol of 1925 (United Nations document A/8052, Annex III).

[4] On 13 July 1952 the People's Republic of *China* issued a statement recognizing as binding upon it the accession to the Protocol in the name of China. The People's Republic of China considers itself bound by the Protocol on condition of reciprocity on the part of all the other contracting and acceding powers.

[5] In a note of 21 November 1966, *Cyprus* declared that it was bound by the Protocol which had been made applicable to it by the British Empire.

[6] *Czechoslovakia* shall cease to be bound by this Protocol towards any state whose armed forces, or the armed forces of whose allies, fail to respect the prohibitions laid down in the Protocol.

[7] The document deposited by *Ethiopia*, a signer of the Protocol, is registered as an accession. The date given is the date of notification by the French government.

[8] In a declaration of succession of 26 January 1973 addressed to the depositary government, *Fiji* confirmed that the provisions of the Protocol were applicable to it by virtue of the ratification by

the United Kingdom. The Protocol is only binding on Fiji as regards states which have both signed and ratified it and which will have finally acceded thereto. The Protocol shall cease to be binding on Fiji in regard to any enemy state whose armed forces or the armed forces of whose allies fail to respect the prohibitions which are the object of the Protocol.

[9] In a declaration of 11 October 1966, *Gambia* confirmed its adherence to the Protocol which had been made applicable to it by the British Empire.

[10] In an official declaration of 13 January 1971 addressed to the depositary government, *Indonesia* reaffirmed its acceptance of the Protocol which had been ratified on its behalf by the Netherlands on 31 October 1930, and stated that it remained signatory to that Protocol.

[11] The government of the Irish Free State does not intend to assume, by this accession, any obligation except towards the states having signed and ratified this Protocol or which shall have finally acceded thereto, and should the armed forces or the allies of an enemy state fail to respect the Protocol, the government of the Irish Free State would cease to be bound by the said Protocol in regard to such state. In a note of 7 February 1972, received by the depositary government on 10 February 1972, *Ireland* declared that it had decided to withdraw the above reservations made at the time of accession to the Protocol.

[12] The Protocol is binding on *Israel* only as regards states which have signed and ratified or acceded to it. The Protocol shall cease to be binding on Israel as regards any enemy state whose armed forces, or the armed forces of whose allies, or the regular or irregular forces, or groups or individuals operating from its territory, fail to respect the prohibitions which are the object of the Protocol.

[13] *Jamaica* declared to the depositary government that it considered itself bound by the provisions of the Protocol on the basis of the ratification by the British Empire in 1930.

[14] The accession by *Jordan* to the Protocol does not in any way imply recognition of Israel, and does not oblige Jordan to conclude with Israel any arrangement under the Protocol. Jordan undertakes to respect the obligations contained in the Protocol with regard to states which have undertaken similar commitments. It is not bound by the Protocol as regards states whose armed forces, regular or irregular, do not respect the provisions of the Protocol.

[15] The accession of *Kuwait* to the Protocol does not in any way imply recognition of Israel or the establishment of relations with the latter on the basis of the present Protocol. In case of breach of the prohibition laid down in this Protocol by any of the parties, Kuwait will not be bound, with regard to the party committing the breach, to apply the provisions of this Protocol. In a note of 25 January 1972, addressed to the depositary government, Israel objected to the above reservations.

[16] By a note of 10 February 1972 addressed to the depositary government, *Lesotho* confirmed that the provisions of the Protocol were applicable to it by virtue of the ratification by the British Empire on 9 April 1930.

[17] The accession to the Protocol does not imply recognition or the establishment of any relations with Israel. The Protocol is binding on *Libya* only as regards states which are effectively bound by it, and will cease to be binding on Libya as regards states whose armed forces, or the armed forces of whose allies, fail to respect the prohibitions which are the object of this Protocol. In a note of 25 January 1972 addressed to the depositary government, Israel objected to the above reservations.

[18] In a declaration of 19 December 1966, *Maldives* confirmed its adherence to the Protocol.

[19] By a notification of 25 September 1970 *Malta* informed the depositary government that it considered itself bound by the Protocol as from 21 September 1964, the provisions of the Protocol having been extended to Malta by the government of the United Kingdom prior to the former's accession to independence.

[20] By a notification of 27 November 1970, *Mauritius* informed the depositary government that it considered itself bound by the Protocol as from 12 March 1968, the date of its accession to independence.

[21] In the case of violation of this prohibition by any state in relation to *Mongolia* or its allies, the government of Mongolia shall not consider itself bound by the obligations of the Protocol towards that state.

[22] Including the Netherlands Indies, Suriname and Curaçao. (On 25 November 1975 Suriname became a sovereign state.)

As regards the use in war of asphyxiating, poisonous or other gases and of all analogous liquids, materials or devices, this Protocol shall cease to be binding on the *Netherlands* with regard to any enemy state whose armed forces or whose allies fail to respect the prohibitions laid down in the Protocol.

[23] In a letter of 18 March 1967, *Niger* declared that it was bound by the adherence of France to the Protocol.

[24] By a note of 13 April 1960, *Pakistan* informed the depositary government that it was party to

the Protocol by virtue of paragraph 4 of the Annex to the Indian Independence Act of 1947.
[25] This is the date of receipt of *Paraguay's* instrument of accession. The date of the notification by the depositary government "for the purpose of regularization" is 13 January 1969.
[26] In a declaration of 21 March 1964, *Rwanda* recognized that it was bound by the Protocol which had been made applicable to it by Belgium.
[27] *Spain* declared the Protocol as binding *ipso facto*, without special agreement with respect to any other member or state accepting and observing the same obligation, that is, on condition of reciprocity.
[28] Included in the ratification by the Netherlands before *Suriname's* independence.
[29] The accession by *Syria* to the Protocol does not in any case imply recognition of Israel or lead to the establishment of relations with the latter concerning the provisions laid down in the Protocol.
[30] By a note of 9 October 1970, *Trinidad and Tobago* notified the depositary government that it considered itself bound by the Protocol, the provisions of which had been made applicable to Trinidad and Tobago by the British Empire prior to the former's accession to independence.
[31] The Protocol only binds the *Union of Soviet Socialist Republics* in relation to the states which have signed and ratified or which have definitely acceded to the Protocol. The Protocol shall cease to be binding on the USSR in regard to any enemy state whose armed forces or whose allies *de jure* or in fact do not respect the prohibitions which are the object of this Protocol.
[32] The Protocol shall cease to be binding on the *United States* with respect to the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials, or devices, in regard to an enemy state if such state or any of its allies fails to respect the prohibitions laid down in the Protocol.
[33] The Protocol shall cease to be binding on *Yugoslavia* in regard to any enemy state whose armed forces or whose allies fail to respect the prohibitions which are the object of the Protocol.

The 1949 Geneva Conventions

Reservations made to the 1949 Geneva Conventions refer to:

Article 10, common to Conventions I, II and III, and Article 11 of Convention IV, all dealing with substitutes for protecting powers (The protecting powers' duty is to safeguard the interests of the parties to the conflict. The parties may agree to entrust to an impartial organization the duties incumbent on the protecting powers by virtue of the Conventions.);

Article 11, common to Conventions I, II and III, and Article 12 of Convention IV, all dealing with conciliation procedure for settling disagreements between parties to the conflict;

Article 13 of Conventions I and II, dealing with protected persons;

Article 4 of Convention III, dealing with the categories of prisoners of war;

Article 12 of Convention III, dealing with responsibility for the treatment of prisoners of war;

Article 66 of Convention III, dealing with the winding up of accounts with prisoners of war on the termination of captivity;

Article 85 of Convention III, dealing with offences committed by prisoners of war prior to capture;

Article 87 of Convention III, dealing with punishment of prisoners of war;

Article 99 of Convention III, dealing with essential rules and general principles of judicial proceedings for prisoners of war;

Article 100 of Convention III, dealing with the death penalty for prisoners of war;

Article 101 of Convention III, dealing with delay in execution of the death penalty pronounced on prisoners of war;

Article 118 of Convention III, dealing with release and repatriation of prisoners of war;

Article 44 of Convention IV, dealing with refugees;

Article 45 of Convention IV, dealing with transfer of protected persons to another power;

Article 46 of Convention IV, dealing with cancellation, after the close of hostilities, of restrictive measures taken with regard to protected persons; and

Article 68 of Convention IV, dealing with penalties, including death penalty, pronounced on protected persons.

Reservations made on signature and subsequently withdrawn are not listed.

[1] Reservations to Article 10 of Conventions I, II and III; to Articles 12 and 85 of Convention III; and to Articles 11 and 45 of Convention IV, made by *Albania, Bulgaria, Byelorussia, China, Czechoslovakia, the German Democratic Republic, North Korea, Poland, Romania, Ukraine, the USSR* and *Viet Nam*.
[2] Succession.
[3] Reservations to Articles 44 and 46 of Convention IV, made by *Brazil*.

[4] With a statement by the *Federal Republic of Germany* that the Conventions are also applicable to *Land* Berlin.
[5] Reservations to Articles 10 and 13 of Convention I; to Articles 10 and 13 of Convention II; to Articles 4 and 10 of Convention III; and to Articles 11 and 45 of Convention IV, made by *Guinea-Bissau*.
[6] Reservations to Article 10 of Conventions I, II and III, as well as Article 11 of Convention IV; to Article 11 of Conventions II and III, as well as Article 12 of Convention IV; to Articles 12 and 85 of Convention III; and to Article 45 of Convention IV, made by *Hungary*.
[7] Reservation made by *Israel* to provisions of Conventions I, II and IV, dealing with the emblem and distinctive sign to be used under the Conventions.
[8] Reservation to Article 66, last paragraph, of Convention III, made by *Italy*.
[9] Reservations to Article 118, paragraph 1, of Convention III; and to Article 68, paragraph 2, of Convention IV, made by *South Korea*.
[10] Reservation to Article 68, paragraph 2, of Convention IV, made by the *Netherlands* and *New Zealand*.
[11] Reservations to Article 44 and Article 68, paragraph 2, of Convention IV, made by *Pakistan*.
[12] Reservations to Article 10 of Conventions I, II, and III; and to Article 11 of Convention IV, made by *Portugal*.
[13] Reservation to Article 99 of Convention III, made by *Spain*.
[14] Reservations to provisions dealing with the emblem and distinctive sign to be used under Convention I; and to Article 68, paragraph 2, of Convention IV, made by the *United States*.
[15] Reservations to Articles 87, 100 and 101 of Convention III; and to Article 68 of Convention IV, made by *Uruguay*.
[16] *Yugoslavia* made the same reservations as those under footnote 1, with the exception of Article 85 of Convention III, to which no reservation was made.

The Protocols to the 1949 Geneva Conventions

Statements of understanding and reservations made on signing the Protocols additional to the 1949 Geneva Conventions refer to:

Protocol I

Article 1, dealing with general principles and scope of application of the Protocol;
Article 41, dealing with safeguards for an enemy *hors de combat;*
Article 44, dealing with combatants and prisoners of war;
Article 51, dealing with protection of the civilian population;
Article 52, dealing with general protection of civilian objects;
Article 53, dealing with protection of cultural objects and of places of worship;
Article 54, dealing with protection of objects indispensable to the survival of the civilian population;
Article 55, dealing with protection of the natural environment;
Article 56, dealing with protection of works and installations containing dangerous forces;
Article 57, dealing with precautions in attack;
Article 58, dealing with precautions against the effects of attack; and
Article 96, dealing with treaty relations upon entry into force of the Protocol.

Protocol II

Part III dealing with wounded, sick and shipwrecked.

[1] Statements on signature reserving the right to make declarations and reservations upon ratification, made by *Australia, Canada, the Federal Republic of Germany, Greece, Italy, Portugal* and *Spain*.
[2] Reservations to Articles 57 and 58 of Protocol I, made by *Switzerland*.
[3] With *UK* statements of understanding in relation to Articles 1, 41, 44, 51–58 and 96 of Protocol I, and the understanding that the new rules introduced by this Protocol are not intended to have any effect on and do not regulate or prohibit the use of nuclear weapons.
[4] With *US* statements of understanding in relation to Article 44 of Protocol I, and Part III of Protocol II, and the understanding that the rules established by Protocol I are not intended to have any effect on and do not regulate or prohibit the use of nuclear weapons.

15. Bilateral arms control agreements

Twenty-two bilateral agreements, treaties, protocols and memoranda of understanding as well as joint or simultaneous statements or declarations in the general field of arms control have been signed since 1963. The parties are, on the one side, the USSR and, on the other, the USA or the UK or France. Most documents are US–Soviet agreements.

The arms control subjects covered in these documents are as follows:

(*a*) limitation of strategic defensive and offensive arms;

(*b*) consultative machinery for implementation of arms control agreements;

(*c*) principles of negotiations for further limitation of strategic arms;

(*d*) prevention of nuclear weapon accidents;

(*e*) prevention of a nuclear war;

(*f*) reduction of fissionable material production;

(*g*) limitation of underground nuclear weapon tests;

(*h*) limitation of nuclear explosions for peaceful purposes;

(*i*) non-proliferation of nuclear weapons;

(*j*) prevention of incidents on the high seas;

(*k*) improvement of communications at government level; and

(*l*) principles of relations between states.

These documents are listed below in chronological order together with a brief summary of their essential provisions.

US – Soviet Memorandum of understanding regarding the establishment of a direct communications link (US–Soviet 'Hot Line' Agreement)

Signed at Geneva on 20 June 1963.
Entered into force on 20 June 1963.

Establishes a direct communications link between the governments of the USA and the USSR for use in time of emergency. An annex attached to the Memorandum provides for two circuits, namely, a duplex wire telegraph circuit and a duplex radio telegraph circuit, as well as two terminal points with telegraph – teleprinter equipment between which communications are to be exchanged.

Statements by the USA and the USSR on the reduction of fissionable materials production

Made on 20 April 1964, simultaneously by the US President and the Soviet Prime Minister.

The US government orders a substantial reduction in the production of enriched uranium, to be carried out over a four-year period. When added to previous reductions, this will mean an overall decrease in the production of plutonium by 20 per cent, and of enriched uranium by 40 per cent.

The Soviet government decides to stop the construction of two new large atomic reactors for the production of plutonium; to reduce substantially during the next few years, the production of uranium-235 for nuclear weapons; and to allocate accordingly more fissionable materials for peaceful uses.

British–Soviet Agreement on the establishment of a direct communications line (British–Soviet 'Hot Line' Agreement)

Signed at London on 25 August 1967.
Entered into force on 27 October 1967.

Establishes a direct teletype communications line between the Kremlin and 10 Downing Street for contacts at government level.

Agreement on measures to improve the USA–USSR direct communications link (US–Soviet 'Hot Line' Modernization Agreement)

Signed at Washington on 30 September 1971.
Entered into force on 30 September 1971.
Amended on 29 April 1975.

Establishes, for the purpose of increasing the reliability of the direct communications link set up pursuant to the Memorandum of understanding of 20 June 1963 (see above), two additional circuits between the USA and the USSR, each using a satellite communications system, and a system of terminals (more than one) in the territory of each party. Matters relating to the implementation of these improvements are set forth in an annex to the Agreement.

Agreement on measures to reduce the risk of outbreak of nuclear war between the USA and the USSR (US – Soviet Nuclear Accidents Agreement)

Signed at Washington on 30 September 1971.
Entered into force on 30 September 1971.

Provides for immediate notification in the event of an accidental, unauthorized incident involving a possible detonation of a nuclear weapon (the party whose nuclear weapon is involved should take necessary measures to render harmless or destroy such weapon); immediate notification in the event of detection by missile warning systems of unidentified objects, or in the event of signs of interference with these systems or with related communications facilities; and advance notification of planned missile launches extending beyond the national territory in the direction of the other party.

US–Soviet Agreement on the prevention of incidents on and over the high seas

Signed at Moscow on 25 May 1972.
Entered into force on 25 May 1972.

Provides for measures to assure the safety of navigation of the ships of the armed forces of the USA and the USSR on the high seas and flight of their military aircraft over the high seas, including rules of conduct for ships engaged in surveillance of other ships as well as ships engaged in launching or landing aircraft. The parties also undertake to give notification of actions on the high seas which represent a danger to navigation or to aircraft in flight, and to exchange information concerning instances of collisions, instances which result in damage, or other incidents at sea between their ships and aircraft.

US–Soviet Treaty on the limitation of anti-ballistic missile systems (SALT ABM Treaty)

Signed at Moscow on 26 May 1972.
Entered into force on 3 October 1972.

Prohibits the deployment of ABM systems for the defence of the whole territory of the USA and the USSR or of an individual region, except as expressly permitted. Permitted ABM deployments are limited to two areas in each country—one for the defence of the national capital, and the other for the defence of some intercontinental ballistic missiles

(ICBMs). No more than 100 ABM launchers and 100 ABM interceptor missiles may be deployed in each ABM deployment area. ABM radars should not exceed specified numbers and are subject to qualitative restrictions. National technical means of verification are to be used to provide assurance of compliance with the provisions of the Treaty.

The ABM Treaty is accompanied by agreed interpretations and unilateral statements made during the negotiations.

US – Soviet Interim Agreement on certain measures with respect to the limitation of strategic offensive arms (SALT Interim Agreement)

Signed at Moscow on 26 May 1972.
Entered into force on 3 October 1972.

Provides for a freeze for up to five years of the aggregate number of fixed land-based intercontinental ballistic missile launchers and ballistic missile launchers on modern submarines. The parties are free to choose the mix, except that conversion of land-based launchers for light ICBMs, or for ICBMs of older types, into land-based launchers for modern 'heavy' ICBMs is prohibited. National technical means of verification are to be used to provide assurance of compliance with the provisions of the Agreement.

A protocol which is an integral part of the Interim Agreement specifies that the USA may have not more than 710 ballistic missile launchers on submarines and 44 modern ballistic missile submarines, while the USSR may have not more than 950 ballistic missile launchers on submarines and 62 modern ballistic missile submarines. Up to those levels, additional ballistic missile launchers—in the USA over 656 launchers on nuclear-powered submarines and in the USSR over 740 launchers on nuclear-powered submarines, operational and under construction—may become operational as replacements for equal numbers of ballistic missile launchers of types deployed before 1964, or of ballistic missile launchers on older submarines.

The Interim Agreement is accompanied by agreed interpretations and unilateral statements made during the negotiations.

In September 1977 the USA and the USSR formally stated that, although the Interim Agreement was to expire on 3 October 1977, they intended to refrain from any actions incompatible with its provisions, or with the goals of the ongoing talks on a new agreement.

Agreement on basic principles of relations between the USA and the USSR

Signed at Moscow on 29 May 1972.

States that the USA and the USSR will proceed from the common determination that in the nuclear age there is no alternative to conducting their mutual relations on the basis of peaceful coexistence. They will do their utmost to avoid military confrontations and to prevent the outbreak of nuclear war. The prerequisites for maintaining and strengthening peaceful relations between the USA and the USSR are the recognition of the security interests of the parties based on the principle of equality and the renunciation of the use or threat of force. The parties will continue their efforts to limit armaments on a bilateral as well as on a multilateral basis. They will continue to make special efforts to limit strategic armaments. Whenever possible, they will conclude concrete agreements aimed at achieving these purposes. They regard as the ultimate objective of their efforts the achievement of general and complete disarmament and the establishment of an effective system of international security in accordance with the purposes and principles of the United Nations.

US–Soviet Memorandum of understanding regarding the establishment of a Standing Consultative Commission

Signed at Geneva on 21 December 1972.
Entered into force on 21 December 1972.

Establishes a Standing Consultative Commission to promote the objectives and implementation of the provisions of the SALT ABM Treaty and Interim Agreement, of 26 May 1972, and of the Nuclear Accidents Agreement of 30 September 1971. Each government shall be represented by a commissioner and a deputy commissioner, assisted by such staff as it deems necessary. The Commission is to hold at least two sessions per year.

Protocol to the US–Soviet agreement on the prevention of incidents on and over the high seas (see above)

Signed at Washington on 22 May 1973.
Entered into force on 22 May 1973.

Provides that ships and aircraft of the parties shall not make simulated attacks by aiming guns, missile launchers, torpedo tubes and other weapons at non-military ships of the other party, nor launch nor drop any objects near non-military ships of the other party in such a manner as to be hazardous to these ships or to constitute a hazard to navigation.

Protocol with regulations regarding the US–Soviet Standing Consultative Commission

Signed at Geneva on 30 May 1973.
Entered into force on 30 May 1973.

Establishes regulations governing procedures and other relevant matters of the Standing Consultative Commission pursuant to the provisions of the US–Soviet Memorandum of understanding of 21 December 1972 (see above).

US–Soviet Agreement on basic principles of negotiations on the further limitation of strategic offensive arms

Signed at Washington on 21 June 1973.

Provides that the two powers will continue negotiations in order to work out a permanent agreement on more complete measures for the limitation of strategic offensive arms, as well as their subsequent reduction. Both powers will be guided by the recognition of each other's equal security interests and by the recognition that efforts to obtain unilateral advantage, directly or indirectly, would be inconsistent with the strengthening of peaceful relations between the USA and the USSR. The limitations placed on strategic offensive weapons could apply both to their quantitative aspects as well as to their qualitative improvement. Limitations on strategic offensive arms must be subject to adequate verification by national technical means. The modernization and replacement of strategic offensive arms would be permitted under conditions formulated in the agreements to be concluded. Pending a permanent agreement, both sides are prepared to reach agreements on separate measures to supplement the SALT Interim Agreement of 26 May 1972. Each power will continue to take necessary organizational and technical measures for preventing accidental or unauthorized use of nuclear weapons under its control in accordance with the Nuclear Accidents Agreement of 30 September 1971.

US–Soviet Agreement on the prevention of nuclear war

Signed at Washington on 22 June 1973.
Entered into force on 22 June 1973.

Provides that the parties will act in such a manner as to exclude the outbreak of nuclear war between them and between either of the parties and other countries. Each party will refrain from the threat or use of force against the other party, against the allies of the other party and against other countries in circumstances which may endanger international peace and security. If at any time relations between the parties or between either party and other countries appear to involve the risk of a nuclear conflict, or if relations between countries not parties to this Agreement appear to involve the risk of nuclear war between the USSR and the USA or between either party and other countries, the Soviet Union and the United States, acting in accordance with the provisions of this Agreement, shall immediately enter into urgent consultations with each other and make every effort to avert this risk.

Protocol to the US–Soviet treaty on the limitation of anti-ballistic missile systems

Signed at Moscow on 3 July 1974.
Entered into force on 25 May 1976.

Provides that each party shall be limited to a single area for deployment of anti-ballistic missile systems or their components instead of two such areas as allowed by the SALT ABM Treaty (see above). Each party will have the right to dismantle or destroy its ABM system and the components thereof in the area where they were deployed at the time of signing the Protocol and to deploy an ABM system or its components in the alternative area permitted by the ABM Treaty, provided that, before starting construction, notification is given during the year beginning on 3 October 1977 and ending on 2 October 1978, or during any year which commences at five-year intervals thereafter, those being the years for periodic review of the ABM Treaty. This right may be exercised only once. The deployment of an ABM system within the area selected shall remain limited by the levels and other requirements established by the ABM Treaty.

US–Soviet Treaty on the limitation of underground nuclear weapon tests (Threshold Test Ban Treaty—TTBT)

Signed at Moscow on 3 July 1974.
Not in force by 31 December 1978.

Prohibits from 31 March 1976 the carrying out of any underground nuclear weapon test having a yield exceeding 150 kilotons. Each party undertakes to limit the number of its underground nuclear weapon tests to a minimum. The provisions of the Treaty do not extend to underground nuclear explosions for peaceful purposes which are to be governed by a separate agreement. National technical means of verification are to be used to provide assurance of compliance and a protocol to the Treaty specifies the data that have to be exchanged between the parties to ensure such verification.

Since the Treaty was not in force by 31 March 1976, the agreed cut-off date for explosions above the established threshold, the parties stated that they would observe the limitation during the pre-ratification period.

Joint US–Soviet Statement on the question of further limitations of strategic offensive arms

Signed in the area of Vladivostok on 24 November 1974.

States that a new US–Soviet agreement on the limitation of strategic offensive arms will incorporate the relevant provisions of the SALT Interim Agreement of 26 May 1972 and will cover the period from October 1977 to 31 December 1985. Based on the principle of equality and equal security, it will include the following limitations: both powers will be entitled to have a certain agreed aggregate number of strategic delivery vehicles and to have a certain agreed aggregate number of intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missile (SLBMs) equipped with multiple independently targetable warheads. The Agreement will include a provision for further negotiations beginning no later than 1980–81 on the question of further limitations and possible reductions of strategic arms after 1985.

Joint British–Soviet Declaration on the non-proliferation of nuclear weapons

Signed at Moscow on 17 February 1975.

Emphasizes the importance and necessity of urgent efforts to prevent the spread of nuclear weapons. The two powers agree that further measures could be undertaken to provide nuclear materials, equipment and information for peaceful uses in non-nuclear weapon states. However, such measures should be under effective safeguards by the IAEA and should not in any way contribute to the spread of nuclear weapons. They express the hope that all suppliers of nuclear material and equipment will observe the safeguards applied by the IAEA to meet article III of the Non-Proliferation Treaty. Until the conclusion of an international agreement for the discontinuance of all test explosions of nuclear weapons for all time, both powers will work for agreements limiting the number of underground nuclear weapon tests to a minimum. The UK and the USSR share a common concern that nuclear materials should be carefully protected at all times.

US–Soviet Treaty on underground nuclear explosions for peaceful purposes (Peaceful Nuclear Explosions Treaty—PNET)

Signed at Moscow and Washington on 28 May 1976.
Not in force by 31 December 1978.

Prohibits the carrying out of any individual underground nuclear explosion for peaceful purposes, having a yield exceeding 150 kilotons, or any group explosion (consisting of two or more individual explosions) with an aggregate yield exceeding 1 500 kilotons. The Treaty governs all nuclear explosions carried out outside the weapon test sites after 31 March 1976. The question of carrying out individual explosions with a yield exceeding 150 kilotons will be considered at an appropriate time to be agreed. In addition to the use of national technical means of verification, the Treaty provides for an exchange of information and, in certain specified cases, access to sites of explosions. A protocol to the Treaty sets forth operational arrangements for ensuring that no weapon-related benefits precluded by the TTBT are derived from peaceful nuclear explosions. The PNET may not be terminated while the TTBT remains in force.

French–Soviet Agreement on the prevention of the accidental or unauthorized use of nuclear weapons (French–Soviet Nuclear Accidents Agreement)

Concluded through an exchange of letters on 16 July 1976 between the foreign ministers of France and the USSR.
Entered into force on 16 July 1976.

Provides that the parties will maintain and, possibly, improve their organizational and technical arrangements to prevent the accidental or unauthorized use of nuclear weapons under their control. They will notify each other immediately of any accidental occurrence or any other unexplained incident that could lead to the explosion of one of their nuclear weapons and could be construed as likely to have harmful effects on the other party. In the event of an unexplained nuclear incident, each party will act in such a manner as to avoid the possibility of its actions being misinterpreted by the other party. For transmission of urgent information, primary use will be made of the direct communications link between the Elysée Palace and the Kremlin. (The link has been established following an accord of 9 November 1966 between France and the USSR.)

French–Soviet Declaration on the non-proliferation of nuclear weapons

Signed at Rambouillet on 22 June 1977.

Reaffirms the common will to spare no effort in seeking to prevent the proliferation of nuclear weapons. The two powers are prepared to contribute to the improvement of IAEA controls over the observance of the commitments assumed in the field of non-proliferation. For their part, they will make sure, each insofar as it is concerned, that their cooperation with third countries in the field of nuclear industry affords all the necessary safeguards to prevent proliferation. In applying their policy of exporting nuclear materials, equipment and technology, the two parties will abide by their international commitments in this field and be guided by the aims of non-proliferation of nuclear weapons. They are prepared to strengthen the appropriate provisions and guarantees relating to equipment, materials and technology, and will continue to contribute to the coordination of the general principles relating to nuclear exports. France and the USSR favour the drafting of an international convention on the physical protection of nuclear materials.

British–Soviet Agreement on the prevention of an accidental outbreak of nuclear war (British–Soviet Nuclear Accidents Agreement)

Signed at Moscow on 10 October 1977.
Entered into force on 10 October 1977.

Provides that the parties will maintain and, whenever necessary, improve their organizational and technical arrangements for guarding against the accidental or unauthorized use of nuclear weapons under their control. They will notify each other immediately of any accident or other unexplained or unauthorized incident which could result in the explosion of one of their nuclear weapons or could otherwise create the risk of the outbreak of nuclear war, and the party whose nuclear weapon is involved will immediately take the necessary measures to render harmless or destroy such a weapon without causing damage. Each party will act in such a manner as to reduce the possibilities of its action being misinterpreted. For transmission of, or requests for, urgent information, the parties will use the direct communications link between their governments.

16. Nuclear explosions

Of 1 165 nuclear explosions reported to have been conducted between 1945 and 1978, mainly to improve the efficiency of nuclear weapons, 667 were carried out after the signing in 1963 of the Partial Test Ban Treaty (PTBT) prohibiting atmospheric tests. Thus, the rate of testing was, on average, 45 per year after the treaty as against 27 before it. The nuclear weapon powers party to the PTBT, namely, the UK, the USA and the USSR, are responsible for over 90 per cent of all nuclear explosions.

After 1963 only China and France, which have not adhered to the PTBT, continued testing nuclear weapons in the atmosphere. However, since 1975, French tests have been made exclusively underground, while China has already conducted four explosions in the underground environment. India has not tested a nuclear device since 1974. (See appendix 16B.)

The US–Soviet Threshold Test Ban Treaty (TTBT), signed in 1974, prohibited underground nuclear tests having a yield in excess of 150 kilotons. Although the TTBT was not in force by 31 March 1976, the agreed cut-off date for explosions above the established threshold, the parties stated that they would observe the limitation during the pre-ratification period. Since that time, all explosions conducted by the USA and the USSR were apparently either below or around the 150-kiloton limit.

In addition to restrictions placed on the size of underground nuclear weapon tests, each party to the TTBT has committed itself to restrict the number of tests to a minimum. The term "minimum" was not defined, but one could have expected some slowing down of the rate of testing by the major powers. Instead, the rate increased as shown below:

Average annual number of US and Soviet explosions in 1973–78

	USA	*USSR*
1973–75	12	16
1976–78	12.3	20

It is also noteworthy that in 1978 the USSR conducted more nuclear explosions than in any other year since 1963. These included a record number of explosions (seven) which, because of their location outside the usual weapon testing sites, are presumed to be for peaceful purposes. These were also apparently held within the limit of a 150-kiloton yield, as stipulated in the 1976 Peaceful Nuclear Explosions Treaty (PNET), not yet in force.

As compared to the figures for the USA and the USSR for the past three years (1976–78)—namely, 37 and 60 explosions, respectively—the testing activities of the other nuclear weapon powers were rather modest: 3 explosions by the UK, 8 by China, and 16 by France. (See appendix 16A.) And it is remarkable that intensive nuclear testing by the major powers coincided with their intensive talks on a comprehensive test ban treaty (CTBT).

The main obstacles to a CTBT seemed to have been overcome already in 1977, when the USSR agreed that on-site inspection may be carried out to verify compliance; that explosions for peaceful purposes would be covered by the treaty; and that participation of all nuclear weapon powers would not be required for the treaty to enter into force. At that time, hopes were high that the trilateral UK–US–Soviet negotiations would be quickly and successfully concluded, that the result of these talks would be referred to the Geneva Disarmament Conference, and that a draft agreed at that conference would be ready by May 1978 for submission to the Special Session of the UN General Assembly devoted to Disarmament. None of these hopes was fulfilled. At the opening phase of the Special Session, the US Vice-President and the Soviet Foreign Minister reported that progress had been made towards an agreement for the cessation of tests. But influential opponents of a comprehensive test ban treaty once again succeeded in delaying attainment of the goal sought by the international community for the past 20 years.

In spite of the generally recognized advances in the technique of detecting and identifying seismic events and the possibility of on-site inspection under certain circumstances, some opponents of the CTBT argue that such a treaty is not verifiable. Those of them who admit that control methods have considerably improved since the negotiations started still demand full verifiability, as if 100 per cent assurance against breaches, even if attainable (which it is not), were indispensable in an arms control agreement. Others, irrespective of the problem of verification, claim that security interests require further testing to develop new nuclear weapon designs, while it is precisely because it would prevent testing for new developments that a CTBT would be of value as an arms control measure. And still others assert that testing is absolutely necessary to confirm the continued reliability of the nuclear stockpiles.

But even if, in the absence of testing, nuclear weapons were actually subject to degradation (which is not at all certain considering the availability of other, non-explosive methods to check their dependability), this would be an important gain for arms control, because by lacking full confidence in their weaponry nuclear powers would be inhibited in planning a first nuclear strike. In other words, resistance against a CTBT can hardly be explained by national security considerations alone.

To be sure, discontinuation of test explosions could not stop all development of nuclear warheads. Certain improvements in nuclear weapons do not require tests involving nuclear reactions, and important improvements in nuclear capabilities can also result from modernization of the delivery vehicles. However, it would at least slow down the qualitative arms race. It would also reinforce the Treaty on the Non-Proliferation of Nuclear Weapons by demonstrating the major powers' awareness of their obligation to bring the nuclear arms race to a halt.

To be of real significance, the ban ought to be complete and of unlimited duration. Yet another limitation of the size or numbers of nuclear explosions, as proposed by some, or a temporary cessation of explosions, as proposed by others, would not meet the commitment to stop "all test explosions of nuclear weapons for all time", as envisaged in the PTBT. In any event, such a half-measure would probably fail to attract wide international support.

Appendix 16A

Nuclear explosions, 1976–78 (known and presumed)

Note

1. The following sources were used in compiling the list of nuclear explosions:
   (*a*) US Geological Survey,
   (*b*) US Department of Energy,
   (*c*) Research Institute of the Swedish National Defence, and
   (*d*) press reports.

2. Unless otherwise indicated, the explosions were carried out underground.

3. Events marked with an asterisk * may be part of a programme for peaceful uses of nuclear energy in view of their location outside the usual weapon testing sites.

4. m_b (body wave magnitudes) and M_s (surface wave magnitudes) indicate the size of the event; the data have been provided by the Hagfors Observatory of the Research Institute of the Swedish National Defence.

5. The yields for 1976 are estimated on the basis of seismological data (see Dahlman, O. and Israelson, H., *Monitoring Underground Nuclear Explosions* [Elsevier Scientific Publishing Company, Amsterdam, 1977]). The yields for 1977 and 1978 are based on US announcements and press reports.

6. In the case of very weak events, it is impossible to distinguish, through seismological methods alone, between chemical and nuclear explosions.

I. Nuclear explosions in 1976

Date (GMT)	Latitude (deg)	Longitude (deg)	Region	m_b	M_s	Yield (kt)
USA						
3 Jan	37.297 N	116.333 W	S Nevada	6.4	5.5	600
4 Feb	37.069 N	116.030 W	S Nevada	6.0		200
4 Feb	37.107 N	116.037 W	S Nevada	5.9		150
12 Feb	37.271 N	116.488 W	S Nevada	6.4	5.4	900
14 Feb	37.243 N	116.420 W	S Nevada	6.2	4.9	350
9 Mar	37.310 N	116.364 W	S Nevada	6.0	5.0	350
14 Mar	37.306 N	116.471 W	S Nevada	6.5	5.3	900
17 Mar	37.256 N	116.312 W	S Nevada	6.3	4.6	500
17 Mar	37.107 N	116.052 W	S Nevada	6.1	4.5	200
12 May	37.209 N	116.212 W	S Nevada	5.1		26
27 Jul	37.075 N	116.044 W	S Nevada	5.7		100
23 Nov	37.172 N	116.053 W	S Nevada			<20
8 Dec	37.079 N	116.002 W	S Nevada	5.1		18
21 Dec	37.124 N	116.067 W	S Nevada	4.6		7
28 Dec	37.100 N	116.036 W	S Nevada	5.8		110
USSR						
15 Jan	49.870 N	78.246 E	E Kazakh	5.5		14
21 Apr	49.818 N	78.198 E	E Kazakh	5.4		10
21 Apr	49.932 N	78.824 E	E Kazakh	6.4		20
19 May	49.856 N	78.007 E	E Kazakh	5.2		<20
9 Jun	50.023 N	79.080 E	E Kazakh	5.9		25
4 Jul	49.915 N	78.952 E	E Kazakh	7.0	4.2	90
23 Jul	49.791 N	78.051 E	E Kazakh	5.4		10
29 Jul	47.782 N	48.120 E	W Kazakh*	6.4	4.2	150
4 Aug	49.9 N	77.7 E	E Kazakh	4.1		2
28 Aug	49.969 N	79.001 E	E Kazakh	6.8	3.5	91
29 Sep	73.404 N	54.817 E	Novaya Zemlya	6.5	3.8	130
20 Oct	73.420 N	54.567 E	Novaya Zemlya		3.4	11
30 Oct	50.2 N	78.1 E	E Kazakh	4.5		3
5 Nov	61.528 N	112.712 E	Central Siberia*	5.4		13
23 Nov	49.991 N	79.005 E	E Kazakh	6.7		120
7 Dec	49.884 N	78.905 E	E Kazakh	7.1		110
30 Dec	49.800 N	78.136 E	E Kazakh	5.5		10
UK						
26 Aug	37.125 N	116.082 W	S Nevada	5.5		64
France						
3 Apr			Mururoa			
11 Jul	22.673 S	138.607 W	Mururoa			
23 Jul			Mururoa			
8 Dec			Mururoa			
China						
23 Jan			Lop Nor			<20 (in atmosphere)
26 Sep			Lop Nor			20 – 200 (in atmosphere)
17 Oct	41.649 N	88.161 E	Lop Nor	5.1		
17 Nov	40.759 N	89.630 E	Lop Nor	4.7	5.1	4000 (in atmosphere)

II. Nuclear explosions in 1977

Date (GMT)	Latitude (deg)	Longitude (deg)	Region	m_b	M_s	Yield (kt)
USA						
5 Apr	37.120 N	116.062 W	S Nevada	6.0	4.0	20–150
27 Apr	37.095 N	116.028 W	S Nevada	5.7		20–150
25 May	37.094 N	116.045 W	S Nevada	5.6		20–150
4 Aug	37.087 N	116.007 W	S Nevada	5.5		20–150
19 Aug	37.111 N	116.055 W	S Nevada	5.9	4.4	20–150
15 Sep	37.033 N	116.043 W	S Nevada			<20
27 Sep	37.151 N	116.068 W	S Nevada	5.1		20–150
26 Oct	37.008 N	116.017 W	S Nevada			<20
1 Nov	37.188 N	116.213 W	S Nevada			<20
9 Nov	37.072 N	116.050 W	S Nevada	6.2	4.3	20–150
17 Nov	37.021 N	116.025 W	S Nevada			<20
14 Dec	37.136 N	116.086 W	S Nevada	5.9		20–150
USSR						
29 Mar	49.790 N	78.149 E	E Kazakh	6.0		
25 Apr	49.837 N	78.159 E	E Kazakh	5.3		
29 May	49.944 N	78.846 E	E Kazakh	7.0	3.7	
29 Jun	50.034 N	78.927 E	E Kazakh	6.4		
26 Jul	69.532 N	90.583 E	Central Siberia*	4.6		
30 Jul	49.777 N	78.163 E	E Kazakh	5.6		
17 Aug	49.814 N	78.151 E	E Kazakh	5.3		
20 Aug	64.223 N	99.577 E	Central Siberia*	4.8		
1 Sep	73.376 N	54.581 E	Novaya Zemlya	6.5	3.7	
5 Sep	50.092 N	78.961 E	E Kazakh	6.7		
30 Sep	47.800 N	48.145 E	W Kazakh*	5.6	3.6	
9 Oct	73.626 N	53.158 E	Novaya Zemlya	5.3		
29 Oct	49.841 N	78.174 E	E Kazakh	5.6		
29 Oct	50.059 N	78.907 E	E Kazakh	6.7	3.9	
30 Nov	49.957 N	78.931 E	E Kazakh	6.9	3.8	
26 Dec	49.881 N	78.141 E	E Kazakh	5.0		
France						
19 Feb	22.100 S	138.762 W	Mururoa			
19 Mar	21.932 S	138.958 W	Mururoa			
6 Jul			Mururoa			
12 Nov			Mururoa			
24 Nov	21.894 S	138.959 W	Mururoa			
17 Dec			Mururoa			
China						
17 Sep			Lop Nor			<20 (in atmosphere)

III. Nuclear explosions in 1978 (preliminary data)

Date (GMT)	Latitude (deg)	Longitude (deg)	Region	m_b	M_s	Yield (kt)
USA						
23 Feb			S Nevada	5.9		20–150
23 Mar			S Nevada	5.9		20–150
11 Apr			S Nevada	5.9		20–150
12 Jul	37.08 N	116.04 W	S Nevada	6.0	4.0	20–150
31 Aug	37.28 N	116.36 W	S Nevada	6.0	4.2	20–150
13 Sep	37.21 N	116.21 W	S Nevada	5.0		<20
27 Sep			S Nevada			20–150
27 Sep			S Nevada	6.2	4.1	20–150
2 Nov	37.287 N	116.296 W	S Nevada			<20
16 Dec			S Nevada	5.9		
USSR						
19 Mar			E Kazakh	5.4		
26 Mar	51.28 N	77.40 E	E Kazakh	6.4		
22 Apr	49.74 N	78.36 E	E Kazakh	5.7	3.3	
29 May			E Kazakh	5.0		
11 Jun	49.91 N	78.89 E	E Kazakh	7.0	4.3	
5 Jul	49.84 N	78.97 E	E Kazakh	6.9	3.9	
28 Jul	49.76 N	78.16 E	E Kazakh	5.9		
9 Aug	63.69 N	125.36 E	Central Siberia*	5.9	3.7	
10 Aug	73.34 N	54.88 E	Novaya Zemlya	6.8	4.1	
24 Aug	65.95 N	112.67 E	Central Siberia*	5.2	3.5	
29 Aug	49.82 N	78.07 E	E Kazakh	5.4		
29 Aug	50.14 N	79.16 E	E Kazakh	6.9	3.9	
15 Sep	49.85 N	78.69 E	E Kazakh	7.0	4.2	
20 Sep			E Kazakh	4.7		
21 Sep	66.43 N	85.84 E	Central Siberia*	4.9		
27 Sep	73.40 N	53.73 E	Novaya Zemlya	6.3	4.2	
8 Oct	61.60 N	112.89 E	Central Siberia*	5.5		
15 Oct	49.756 N	78.261 E	E Kazakh	5.5		
17 Oct	47.906 N	48.209 E	W Kazakh*	6.3	4.3	
17 Oct	63.207 N	63.194 E	N Ural*	5.8	3.6	
31 Oct	49.886 N	78.137 E	E Kazakh	5.6		
4 Nov	50.019 N	79.024 E	E Kazakh	6.5	3.9	
29 Nov	49.920 N	78.089 E	E Kazakh	5.6		
29 Nov	50.004 N	78.951 E	E Kazakh	7.1	4.2	
14 Dec			E Kazakh	5.0		
18 Dec			W Kazakh*	6.4	5.0	
20 Dec			E Kazakh	4.7		
UK						
11 Apr			S Nevada	5.6		20–150
18 Nov	37.126 N	116.084 W	S Nevada	5.6		20–150
France						
27 Feb			Mururoa			
22 Mar			Mururoa			
19 Jul			Mururoa			
26 Jul			Mururoa			
2 Nov			Mururoa			
30 Nov	21.926 S	138.967 W	Mururoa			
China						
15 Mar			Lop Nor			<20 (in atmosphere)
14 Oct			Lop Nor	5.4		
14 Dec						(in atmosphere)

Appendix 16B

Nuclear explosions, 1945–78 (known and presumed)

I. 16 July 1945–5 August 1963 (the signing of the Partial Test Ban Treaty)

USA	USSR	UK	France	Total
293	164	23	8	**488**

II. 5 August 1963 – 31 December 1978

a atmospheric
u underground

	USA		USSR		UK		France		China		India		
Year	a	u	a	u	a	u	a	u	a	u	a	u	Total
5 Aug-31 Dec 1963	0	14	0	0	0	0	0	1					**15**
1964	0	28	0	6	0	1	0	3	1	0			**39**
1965	0	29	0	9	0	1	0	4	1	0			**44**
1966	0	40	0	15	0	0	5	1	3	0			**64**
1967	0	29	0	15	0	0	3	0	2	0			**49**
1968	0	39[a]	0	13	0	0	5	0	1	0			**58**
1969	0	28	0	15	0	0	0	0	1	1			**45**
1970	0	33	0	12	0	0	8	0	1	0			**54**
1971	0	15	0	19	0	0	5	0	1	0			**40**
1972	0	15	0	22	0	0	3	0	2	0			**42**
1973	0	11	0	14	0	0	5	0	1	0			**31**
1974	0	9	0	19	0	1	7	0	1	0	0	1	**38**
1975	0	16	0	15	0	0	0	2	0	1	0	0	**34**
1976	0	15	0	17	0	1	0	4	3	1	0	0	**41**
1977	0	12	0	16	0	0	0	6	1	0	0	0	**35**
1978	0	10	0	27	0	2	0	6	2	1	0	0	**48[b]**
Total	**0**	**343**	**0**	**234**	**0**	**6**	**41**	**27**	**21**	**4**	**0**	**1**	677

III. 16 July 1945–31 December 1978

USA	USSR	UK	France	China	India	Total
636	398	29	76	25	1	**1 165**

[a] Five devices used simultaneously in the same test (Buggy) are counted here as one.
[b] The data for 1978 are preliminary.

17. Confidence-building in Europe

Square-bracketed numbers, thus [1], *refer to the list of references on page 662.*

I. Notification of military activities

A meeting was held in Belgrade from 4 October 1977 to 9 March 1978 to review progress in implementing the provisions of the Final Act of the Conference on Security and Co-operation in Europe (CSCE), signed in 1975 by 33 European states, the USA and Canada.

The Final Act of the CSCE consists of the following main parts: questions relating to security in Europe; cooperation in the fields of economics, of science and technology and of the environment; questions relating to security and cooperation in the Mediterranean; cooperation in humanitarian and other fields; and follow-up to the CSCE. Only one chapter (in the part on security questions in Europe) is directly related to military issues. This chapter, entitled "Document on confidence-building measures and certain aspects of security and disarmament", contains sections on prior notification of major military manoeuvres; prior notification of other military manoeuvres; exchange of observers; prior notification of major military movements; other confidence-building measures; questions relating to disarmament; and general considerations. (For an analysis and for the text of the Document, see *SIPRI Yearbook 1976* [1].)

The purpose of the Document on confidence-building measures was formulated in its preamble as follows: "to contribute to reducing the dangers of armed conflict and of misunderstanding or miscalculation of military activities which could give rise to apprehension, particularly in a situation where the participating States lack clear and timely information about the nature of such activities". However, most of the provisions in the Document are vague and non-committal, or simply confirm a practice which already exists among nations maintaining normal relations. The only clause stated in concrete terms is that concerning notification of major military manoeuvres in Europe, to be given at least 21 days in advance or, in the case of a manoeuvre arranged at shorter notice, at the earliest possible opportunity prior to its starting date. The term "major" means that at least 25 000 troops are involved. Notification of manoeuvres with fewer men "can" also be made, especially if they involve land forces together with "significant numbers" of either amphibious or airborne troops, or both. The following information is to be provided in the notification of each major manoeuvre: the designation (code-name), if any; the general purpose; the states involved; the types and numerical strength of the forces engaged; the area; and the estimated time-frame of its conduct. States may give additional information, particularly that related to the components of the forces engaged and the period of involvement of the troops. They may invite observers to attend the manoeuvres. Notification of "smaller-scale" military manoeuvres, especially to states which lie near the area of these manoeuvres, is considered advisable. States may also, "at their own discretion", give notification of their major military movements.

The CSCE Document states that notification of manoeuvres "rests upon a voluntary basis"; it is therefore not a legally binding commitment. Nonetheless, it is a declaration of intent solemnly adopted by the representatives of the participating states at the highest possible level, and the parties have accepted the "responsibility of each of them" to implement this measure. The undertaking was a modest first step towards greater openness in military affairs.

At the Belgrade meeting, the record of the implementation of the relevant provisions was found satisfactory in that apparently no participating state had failed to notify "major" manoeuvres. (For the list of manoeuvres notified in 1978, see appendix 17A. Those notified in preceding years are listed in reference [2].) However, in a number of cases the information given in notifications was rather scanty. A few states went beyond the minimum provisions and notified smaller-scale manoeuvres, that is, below the 25 000 troop level, but they did not always do so within the prescribed time-limit. No independent air or naval exercises were notified. At certain manoeuvres, the observers invited to attend were not given an opportunity properly to follow them. Sometimes the period of the involvement of troops in the manoeuvres was indicated, in addition to the time-frame of the manoeuvres themselves, but no state has notified a major military movement carried out independently of manoeuvres.

The CSCE Final Act stipulates that the experience gained by the implementation of its provisions could lead to "developing and enlarging measures aimed at strengthening confidence". Accordingly, participants at the 1977–78 Belgrade meeting came forward with proposals: (*a*) to reinforce the existing provisions on the notification of military manoeuvres and movements; (*b*) to restrict the above-mentioned and other military activities; and (*c*) to adopt certain measures not specifically mentioned in the Final Act. Proposals under category (*a*) concerned the provision of more details in the notification of manoeuvres; establishing a practice of notifying also small-scale manoeuvres, defined as those involving 10 000–25 000 troops, or of such smaller manoeuvres which take place close to each other in time and space and cumulatively involve more than 25 000 troops; notification of air and naval manoeuvres, in particular naval manoeuvres that are conducted near territorial waters of other states; notice about manoeuvres to be given earlier than hitherto (for example, 30 days in advance instead of 21); increasing the exchanges of observers at manoeuvres, among other ways, by extending invitations to a greater number of states; establishing a code for treatment of these observers; and, finally, notification of major ground force movements involving more than 25 000 troops, as well as smaller movements conducted close to the borders of other states. The above proposals were made by NATO member states and/or neutral/non-aligned countries participating in the meeting. Romania, a member of the Warsaw Treaty Organization, supported the idea of prior notification of air and naval manoeuvres and of force movements.

Proposals under category (*b*) included a limitation on the size of manoeuvres to 50 000–60 000 men (proposed by the USSR) and a ban on multinational manoeuvres in border areas (proposed by Romania).

Proposals under category (*c*) provided for a ban on new military bases in Europe, including nuclear weapon sites, and on increases in troops stationed there (proposed by Romania); a treaty on the non-first-use of nuclear weapons, as well as a treaty prohibiting the enlargement of political and military alliances in Europe (proposed by the USSR); a ban on the production of neutron weapons (proposed by the German Democratic Republic); a freeze on military budgets (proposed by Romania); and presentation of statistics concerning defence expenditures (proposed by Sweden). The Soviet proposals, incorporated in a document entitled "Programme of action with a view to the consolidation of military détente in Europe", were not meant to be agreed upon at Belgrade, but to be discussed at "special joint consultations by all states participating in CSCE", in parallel with the Vienna negotiations for the reduction of forces in Central Europe.

Suggestions which went beyond the framework of the CSCE Final Act had little chance of being seriously considered in Belgrade, since there was strong opposition to widening the mandate of the meeting. Some suggestions were more of an arms-control than a confidence-building nature. Others raised issues between military blocs and were therefore out of context in an all-European discussion. Most had been presented before and rejected.

However, strengthening the confidence-building measures already provided for in the CSCE Final Act would have been entirely in order, as this would conform to the envisaged goal to "develop" and "enlarge" them. As regards military manoeuvres, the value of prior notification would increase if more information were given by the notifying states. The 25000 level for troops engaged in manoeuvres to be notified should have been reduced on a mandatory basis, considering that in certain areas of Europe manoeuvres of forces even substantially below that level may cause alarm when they are conducted in the vicinity of other countries and with units especially trained for invasion purposes. Notification of "major" manoeuvres could certainly be given more in advance of their starting date, as it is unlikely that such manoeuvres are arranged at short notice. And, to promote good-will, it would be desirable to make the attendance of observers at the manoeuvres more meaningful.

Similar, if not stronger, considerations apply to military movements other than manoeuvres. Transfer of combat-ready army, naval and air force units outside their permanent garrison or base areas, especially over long distances and close to the borders of other states, might be mistaken for preparations for a hostile action. Such transfer ought, therefore, to be notified to reduce uncertainties and avoid the dangers inherent in any such misunderstanding.

Agreement was not reached in either field, the Warsaw Treaty countries (with the exception of Romania) arguing that there had been, as yet, too little experience with existing confidence-building measures to justify further undertakings, and that, in any event, progress in this respect could only go hand-in-hand with progress in détente in general and in disarmament in particular. The proposal put forward by the neutral/non-aligned states for setting up a post-Belgrade working group to examine the pertinent issues was found unacceptable by the USA and the USSR.

Thus, the Belgrade meeting failed to enhance the role of confidence-building measures in strengthening security in Europe. Nevertheless, the Concluding Document of the meeting has assured the continuation of the CSCE process through agreement to a further follow-up conference in Madrid in 1980, where the topic of confidence-building will again be taken up for discussion.

II. Peaceful settlement of disputes

Following a recommendation contained in the Belgrade CSCE Concluding Document, a meeting of experts was held at Montreux, Switzerland, from 31 October to 11 December 1978, to discuss a subject closely related to confidence-building in Europe, namely, the peaceful settlement of disputes.

It will be recalled that the CSCE Final Act stipulates that states will use such means as negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means of their own choice including any settlement procedure agreed to in advance of dispute to which they are parties; that, in the event of failure to reach a solution by any of the above means, the parties will continue to seek a mutually agreed way to settle the dispute peacefully; and that they will refrain from any action which might aggravate the situation and make a peaceful settlement more difficult (see the chapter of the Final Act on principles guiding relations between participating states). The CSCE participants decided to pursue the examination and elaboration of a generally acceptable method for the peaceful settlement of disputes aimed at complementing existing methods (see the chapter of the Final Act on matters related to giving effect to certain principles). It is this decision that formed the mandate for the Montreux meeting where different proposals were put forward and discussed.

Switzerland (supported by some neutral and non-aligned states) proposed a "subsidiary and compulsory" mechanism for peaceful settlement of disputes, the essential features of which are as follows: (*a*) unless otherwise agreed, the participating states are obliged to settle their disputes by negotiation; (*b*) no state may refuse an invitation to negotiate; and (*c*) if after a certain time—for instance, three years—no agreement has been reached, each party shall be entitled to have recourse to a commission for enquiry, conciliation and mediation, or to an arbitral tribunal, provided that the dispute is of a legal nature and involves the topics agreed in advance and contained in a list.

The list under (*c*) would cover the following areas: responsibility in international law; problems of the law of neighbours (for instance, international servitudes, establishment of frontiers or regulation of international waterways); transport law (rail, road, air); environmental problems; diplomatic and consular law; diplomatic protection; questions of penal law; interpretation and application of international treaties (excluding treaties of alliance); as well as validity, entry into force and termination of treaties.

The participating states would hold periodic review conferences with a view to the further development of the system.

Belgium, Canada, Denmark, the Federal Republic of Germany, Italy, the Netherlands, Portugal, the UK and the USA were of the view that some disputes (within certain well-defined categories) should, as a matter of obligation and at the request of either party, be subject to arbitration. Other disputes would, also as a matter of obligation and at the request of either party, be submitted to inquiry, mediation or conciliation, the results of which would be non-binding, unless the parties agreed otherwise. (France was prepared to resort to judicial settlement only in cases of disputes over interpretation and application of treaties.)

Another proposal, put forward by Czechoslovakia, the German Democratic Republic, Poland and the USSR, stated that the participating states should, when a dispute arises, enter into mutual consultations with a view to its peaceful settlement. Consultations must commence not later than two months following a request that they be held. A state addressed with the request would be "obliged" to enter into consultations, but the place and procedure would be determined jointly by the parties. Should the parties reach no agreement concerning the venue of the consultations, these would be held in a place fixed in advance. The parties to a dispute may, by mutual agreement, invite other states to take part in the consultations. Upon the conclusion of the consultations, a document would be drawn up, establishing modalities for the settlement of the dispute or specifying agreed measures.

As distinct from other proposals, the method suggested by Czechoslovakia, the GDR, Poland and the USSR contained no provision for third party procedures to be resorted to should the parties fail to arrive at a common solution to their dispute. This attitude may reflect the traditional scepticism of these countries as regards the impartiality of international tribunals, especially in major East–West controversies.

Because of the fundamental differences of approach, and relatively weak interest in the subject-matter of the meeting on the part of most NATO and WTO countries, the working out of a specific, generally acceptable method for peaceful settlement of disputes in Europe did not prove feasible at Montreux. Nevertheless, due to diplomatic efforts by some neutral/non-aligned delegations, the participants agreed that in elaborating such a method, the following requirements would have to be taken into account:

(*a*) consistency with the principles and the purposes of the UN Charter and the Final Act of the CSCE;

(*b*) consistency with the sovereign equality of states and the free choice of means;

(*c*) experience as well as treaty and diplomatic practice and the views of all the participating states in this field;

(*d*) acceptability to all participating states irrespective of their political, economic or social systems as well as of their size, geographic location or level of economic development;

(*e*) subsidiarity to existing methods and institutions for the peaceful settlement of international disputes;

(*f*) complementarity to existing methods so as to promote, in good faith and in a spirit of cooperation, a rapid and equitable solution on the basis of international law;

(*g*) flexibility of the method; and

(*h*) capacity for progressive development of the method.

In their report, the participants in the Montreux meeting recommended that governments should consider the possibility of convening another meeting of experts, which would take into account the above guidelines as well as the proposals and ideas discussed. They also recommended that the practice of including provisions for the peaceful settlement of disputes in appropriate inter-state treaties should be promoted and extended.

The problem of settlement of disputes in Europe is very likely to come up again for discussion in view of its importance for the maintenance of international peace and security, for arms control and disarmament.

References

1. *World Armaments and Disarmament, SIPRI Yearbook 1976* (Almqvist & Wiksell, Stockholm, 1976, Stockholm International Peace Research Institute), pp. 323 – 29, 359 – 62.
2. *Arms Control, A Survey and Appraisal of Multilateral Agreements* (Taylor & Francis, London, 1978, Stockholm International Peace Research Institute), pp. 223 – 27.

Appendix 17A

Notifications of military manoeuvres in 1978, in compliance with the Final Act of the Conference on Security and Co-operation in Europe

State giving notification	Date of notification	Duration of manoeuvre	Designation of manoeuvre	Number of troops involved	Area of manoeuvre
USSR	16 Jan	6–10 Feb	Berezina[1]	c. 25 000	Byelorussian military district: Minsk–Orsha–Polotsk
Norway	30 Jan	1–6 Mar	Arctic Express[2]	15 300	Troms, northern Norway
German DR	12 Jun	3–8 Jul	. .[3]	c. 30 000	Stendal – Magdeburg – Lieberose
Denmark	11 Aug	19–22 Sep	Bold Guard 78[4]	c. 6 000[5]	FR Germany and Denmark
USSR	15 Aug	5–12 Sep	. .[6]	c. 25 000	Kutaisi – Batumi – Kirovobad
FR Germany	18 Aug	19–22 Sep	Bold Guard 78[4]	65 000	Schleswig-Holstein
Norway	23 Aug	22–26 Sep	Black Bear[7]	8 200	Aust-Agder region in southern Norway, north and east of Kristiansand
USA	23 Aug	17–21 Sep	Blaue Donau[8]	46 000	FR Germany
USA	23 Aug	18–28 Sep	Certain Shield[9]	c. 56 000	FR Germany: Fulda area, north-east of Frankfurt
USA	23 Aug	18–29 Sep	Saxon Drive[10]	32 500	FR Germany
FR Germany	24 Aug	17–21 Sep	Blaue Donau[8]	46 000	Nürnberg – Regensburg – Augsburg – Ulm
FR Germany	25 Aug	18–28 Sep	Certain Shield[9]	c. 56 000	Bad Hersfeld – Schweinfurt – Darmstadt – Limburg – Marburg
FR Germany	25 Aug	18–29 Sep	Saxon Drive[10]	c. 33 000	Lüneburg – Wolfsburg – Hannover – Bersenbrück – Oldenburg – Bremen
Netherlands	28 Aug	18–29 Sep	Saxon Drive[10]	32 500	FR Germany: Barssel – Bersenbrück – Stolzenau – Oebisfelde – Bodenteich – Gartow – Artlenburg – Bremen
Austria	23 Oct	13–17 Nov	. .[11]	5 000	Weinviertel/Lower Austria
USA	28 Dec	30 Jan – 7 Feb 1979	Certain Sentinel[12]	c. 66 000	Northern Baden-Württemberg, eastern Bavaria

[1] Purpose of the "Berezina" manoeuvre: cooperation of different types of forces.
Participating units: army and air force.
Foreign observers were invited to attend.

[2] This multinational field exercise was part of the NATO manoeuvre "Arctic Express" which took place on 14 February – 14 March 1978 in the framework of the "Express" series.
Purpose of the manoeuvre: routine exercise of NATO procedures for the deployment of forces and cooperation with Norwegian troops under winter conditions. Command level: Commander, north Norway.
Participating units: Norwegian 6th Division, Combined Regiment No. 5 and other smaller units; Allied Command Europe Mobile Forces (AMF) land and air components; UK Marine unit (battalion size) including one Netherlands Marine company; and two companies of US Marines. In addition to AMF air components, smaller allied air units and small Norwegian naval forces were to participate.
Absence from garrisons: from 20 February until a few days after the end of the manoeuvre.

[3] Participating units: ground and air units of the Soviet forces stationed in the GDR.

[4] "Bold Guard"—allied manoeuvre with opposing forces.
Purpose of the manoeuvre: to exercise cooperation among staffs and troops as well as joint action of mechanized and amphibious units with the support of air force units under rapidly changing conditions. Command level: Commander Allied Forces Baltic Approaches (COMBALTAP), Karup, Denmark.
Participating units: parts of Jutland Division (Denmark); parts of 6th Mechanized Division, parts of Home Defence Command 13, 7th Mechanized Division (FRG); parts of UK Mobile Ground Forces; 4th Marine Amphibious Brigade (USA).

[5] This is a contribution of the forces of the notifying country only.

[6] Purpose of the manoeuvre: to train cooperation of different branches of service.
Participating units: infantry and air force units from the Kavkaz military district.

[7] "Black Bear"—a multinational combined manoeuvre.
Purpose of the manoeuvre: refresher training for Norwegian units and field exercise of allied forces together with Norwegian forces. Command level: Commander Allied Forces South Norway (COMSONOR).
Participating units: Norwegian Combined Regiment No. 6 and other smaller Norwegian units; one US para battalion; one UK Marine brigade including one combat group Netherlands Marines; units from Norwegian Air Force and two allied air squadrons.

[8] "Blaue Donau"—manoeuvre with ground troops (with opposing forces) supported by air force units.
Purpose of the manoeuvre: training of troops, commanders and staffs in combat operations and in cooperation with allied forces, the territorial army and air force units.
Participating units: 1st Mountain Division, 10th Armoured Division, 1st Airborne Division, Home Defence Command 18, support and supply units, one US brigade and 4th Canadian Mechanized Brigade.
Absence from garrisons: 11 – 16 to 26 September.
Foreign observers were invited to attend.

[9] "Certain Shield"—an allied field training manoeuvre, combining defensive and counter-attack operations, in the context of the "Autumn Forge" series of national and multinational field training and command post exercises conducted by members of NATO. "Certain Shield" included US troops transported to Europe in the "Reforger 78 Movement".
Purpose of the manoeuvre: to exercise in-country and "Reforger" forces in river-crossing operations, as well as armoured-mechanized infantry actions in varying defence, withdrawal and counter-attack operations.
Participating units: 5th Corps (USA); one armoured brigade (FRG); Task Force Delta (UK); one cyclist battalion (Belgium); one infantry company (Luxembourg).
Foreign observers were invited to attend.

[10] Purpose of the "Saxon Drive" manoeuvre: training of commanders and staff in various combat related techniques; training of reserve units; exercising cooperation with units of NATO partners. Command level: Commander 1st Netherlands Army Corps.
Participating units: units of three Netherlands brigades from two Netherlands divisions; two US brigades; one FRG battalion.
Foreign observers were invited to attend.

[11] Staff manoeuvre and telecommunications exercise with units from 1st Mechanized Division of the Austrian Army.
Purpose of the manoeuvre: reinforced mechanized brigade in protective operation at division level.

Participating units: Command of 1st Mechanized Division, staffs of 3rd and 4th Mechanized Brigades, reinforced 9th Mechanized Brigade.

12 "Certain Sentinel"—an allied field training manoeuvre including US troops transported to Europe in the "Reforger 79 Movement".

Purpose of the manoeuvre: to exercise in-country and "Reforger" forces in a number of operations designed to enhance interoperability, combined arms training and river crossings.

Participating units: 7th Corps (USA); 14th Armoured Brigade (FRG); infantry battalion (Luxembourg); 4th Mechanized Brigade Group (Canada); signal regiment (UK); 1st Artillery Battalion (Netherlands).

Foreign observers were invited to attend.

18. NGOs and disarmament

Square-bracketed numbers, thus [1], *refer to the list of references on page 679.*

I. Introduction

The lack of progress in disarmament negotiations is in particular attributed to the lack of political volition which, it is widely believed, can be enhanced by world public opinion—especially in the field of disarmament. Public opinion is both stimulated by, and reflected in, non-governmental organizations (NGOs) and the media. Both NGOs and the mass media have been increasingly involved with the UN system. NGO involvement, however, is very recent.

The League of Nations dealt with NGOs, among other times, at its Disarmament Conference which began in 1932.[1]. The UN Charter provided an explicit role for NGOs under Article 71, on which authority the Secretariat of the Economic and Social Council (ECOSOC) has evolved consultative arrangements with several hundred NGOs over three decades. These arrangements have been confined, however, to economic and social issues, and disarmament has been considered only tangentially.

Outside of Article 71, specialized and other agencies within the UN system, notably the UN Educational, Scientific and Cultural Organization (UNESCO), the Food and Agriculture Organization (FAO), the UN Children's Fund (UNICEF), and the UN Environment Programme (UNEP), gave official recognition to NGOs.

In addition, there has been a succession of General Assembly resolutions referring to NGOs. These have tended to ask help of NGOs either in obtaining material for UN studies or in distributing these studies once made. One of the earliest, in 1965, requested information about studies on the economic and social consequences of disarmament "undertaken by non-governmental organizations" [2]. In 1975, "relevant international organizations were [invited] to use their facilities to make the special report [on nuclear weapon-free zones] widely known" [3]. "The value of holding conferences of experts and scientists from various countries on the problems of the arms race and disarmament" had already been affirmed in 1971, and "universities and academic institutes" urged to establish "continuing courses and seminars to study problems of the arms race" [4]. In 1976, NGOs were called upon to "further the goals of the Disarmament Decade" [5]. However, no resolution was adopted which gave NGOs a consultative role in disarmament matters equal to that in the economic and social field.

A Special NGO Committee on Disarmament was created in Geneva in 1969—one of several committees created in Geneva and New York by the Conference of Non-Governmental Organizations in Consultative Status with the UN Economic and Social Council (CONGO). In 1973, the NGO Committee on Disarmament was established and set up at UN Headquarters. Both committees focused the concerns of dozens of general and specialized NGOs on disarmament issues as they arose in the UN system [6].

Outside of the UN system, NGOs have been involved in the First Committee, the Conference of the Committee on Disarmament (CCD), several ad hoc committees (on the Indian Ocean and a World Disarmament Conference), and in the first Non-Proliferation Treaty Review Conference in 1975 [7].

At a conference sponsored by the International Peace Bureau in Bradford, England, in August 1974 to support efforts to convene a World Disarmament Conference (WDC), far-reaching proposals were made for NGOs. Thirty NGOs, with full rights of participation other than voting rights, should be invited and receive adequate funds to ensure the preparation and distribution of documentation and to ensure proper representation at the WDC. All NGOs in consultative status with ECOSOC should be given normal observer status at the WDC and all relevant documentation should be circulated by the UN to and from NGOs directly concerned with disarmament [8]. This declaration was subsequently endorsed by many international and national NGOs.

II. NGOs within the UN field of disarmament

A role for NGOs

In 1975, a resolution was adopted to create an Ad Hoc Committee on the Review of the Role of the UN in the Field of Disarmament [9]. This was viewed by some states and many NGOs as a possible venue to discuss and establish a future role for NGOs. Indeed, of the 42 member states of the UN which initially responded to an inquiry from the Secretary-General on their suggestions for the entire work of the Ad Hoc Committee, nine gave favourable mention to the role of NGOs—Canada, Costa Rica, Finland, Ireland, New Zealand, Norway, Romania, Sweden and Venezuela.

In June 1976, 13 international NGOs submitted to the Ad Hoc Committee a joint statement on strengthening the role of international

NGOs in the field of disarmament [10]. This proposed that NGOs (*a*) be accorded observer status in the First Committee of the General Assembly; (*b*) be associated with the preparation, proceedings and implementation of any future Special Session on Disarmament or a WDC; (*c*) be asked to communicate their views and suggestions on disarmament matters to the Secretary-General wherever such views are required of member states and specialized agencies; (*d*) be accorded official or unofficial hearings by disarmament bodies; (*e*) be given all UN documents on disarmament issues; (*f*) be urged to participate in the preparation and proceedings of review conferences; and (*g*) be given some access to disarmament negotiating forums.

During the three sessions of the Ad Hoc Committee in 1976, it soon became evident that no thorough exploration of the role of NGOs, let alone any innovation relating to them, would be permitted during the meetings. A proposal that communications to the Committee by NGOs be officially circulated was never implemented. A proposal for an informal hearing of NGOs by the Committee could not be put into effect. Even the working paper submitted by Sweden did not mention the role of NGOs except within the context of studies. This text was then altered by eliminating reference to NGOs, so that in the Committee's final report to the General Assembly [11], disarmament studies were suggested "with the assistance of qualified experts nominated by Governments and with the assistance, whenever appropriate, from other sources". The latter were disappointed not only with its failure to give a role to NGOs in future disarmament work, but also with the total findings of this Committee.

Preparations for the Special Session

In 1976, the non-aligned states introduced a resolution convening a Special Session Devoted to Disarmament in mid-1978. Attempts were made by some states and NGOs to insert a role for NGOs in the draft resolution. For various reasons, the non-aligned leadership would not yield to these requests, asserting that they wanted the draft resolution to be adopted by consensus [12]. However, NGOs saw the Special Session as an opportunity, not unlike the League of Nations Disarmament Conference, to make a special impact.

In the first session of the Preparatory Committee, in March 1977, it was stated that the Special Session would involve "world public opinion and the organizations, governmental and non-governmental, that are active in mobilizing this opinion".[1] Several member states of the

[1] Opening speech by UN Secretary-General Kurt Waldheim.

54-nation Committee, and several NGOs, immediately raised the question of a role for NGOs. At the end of the first session it was announced that the Bureau—the Chairman, the Rapporteur, and vice-presidents from eight states—would consider the question and a decision would be announced at the second session. During the interim, NGOs were active in promoting a role. Member states also responded to an inquiry of the Secretary-General, with eight urging involvement by NGOs: Austria, Finland, Iran, Italy, Mexico, Norway, Sweden and Venezuela.

The following recommendations for the role of NGOs were made at a Stanley Foundation Conference [13], which was attended by many of the participants at the second session of the Preparatory Committee on the following day. The recommendations therefore received serious consideration: (*a*) it would be desirable for the Preparatory Committee and the Special Session itself to welcome the participation of NGOs; (*b*) any NGO having status with any organ within the UN system could request the UN Centre for Disarmament to place it on a Register of NGOs for the Special Session; (*c*) NGOs on the Register would have the same access as NGOs during the regular sessions of the General Assembly to plenary meetings of the Special Session, and its committees, and similar access to Special Session documents; (*d*) the Centre could periodically make available to member states an annotated list of documents submitted by NGOs on the Register; and (*e*) NGO statements up to 1 000 words in length could be given, either in writing or orally, to a plenary session or a committee of the Special Session, provided that they would be submitted on behalf of a group of 25 or more NGOs on the Register or, alternatively, the Bureau could convene informal meetings of NGOs for an exchange of views.

The establishment of "an independent NGO-sponsored periodical, open to a wide range of NGO and peace research institute viewpoints" was also proposed.

At the opening meeting of the second session of the Preparatory Committee on 9 May, it was reported that the Bureau had unanimously approved the following proposals relating to NGOs. The Committee then adopted these by consensus.

1. A well-informed public opinion, be it at national or international levels, can bring significant contributions toward progress in the field of disarmament. The non-governmental organizations, whose dedication and interest in this field is well-known and highly appreciated by the members of this Committee, could play a stimulating and constructive role in channeling the public concerns in this matter.

2. The officers of this Committee are pleased to realize the NGOs' interest in closely following the development of its work and hope that this association will be further strengthened by the continued presence of its representatives in the usual places in this room.

3. Notwithstanding the frequent and useful contacts or exchanges that take place between NGOs and individual delegations, and in order to facilitate the knowledge of non-governmental contributions, the Secretariat will provide lists of general circulation of the communications received from the NGOs and institutions known to be conducting research in the field of disarmament. The lists will indicate where the communications and any annexed documentations will be available to delegations [14].

NGOs were quick to implement the formal roles assigned to them in the Preparatory Committee. Several dozen international and national NGOs—the Committee made no distinction—sent observers to the five sessions of the Committee. These included such international organizations as the Friends World Committee for Consultation, the Women's International League for Peace and Freedom, the World Council of Churches, the World Conference on Religion and Peace, and the Stockholm International Peace Research Institute (SIPRI). National groups sending observers included the Maryknoll Fathers, Project Ploughshares of Canada, and the Stanley Foundation. Such efforts were partly coordinated by the NGO Committee on Disarmament whose officers were in constant consultation with the officers of the Preparatory Committee, many delegates, and members of the Secretariat.

NGOs took advantage of the new procedure of submitting statements and other materials. The Secretariat released lists of these submissions as official documents [15, 16]. A very wide range of organizations submitted statements and the Secretariat helped make the NGO literature immediately available to delegates.

Other NGO activity

This NGO activity in UN Headquarters during the sessions of the Preparatory Committee was the result of much greater NGO activity at both the international and national levels. A number of NGOs sponsored, individually or collectively, conferences, seminars and other meetings to learn about the issues of the Special Session, to formulate their own policies, and in some cases to start dialogues with diplomats and governments.

NGOs working especially with diplomats included the Stanley Foundation, the Quaker UN Office (which sponsored a lengthy series of meetings for Third World diplomats), the Carnegie Endowment/Arms Control Association [17], and the International Peace Academy [18].

The International NGO Conference on Disarmament, held in Geneva in early 1978, was yet another opportunity for a large group of NGOs to discuss the Special Session. Sponsored by the two NGO committees on disarmament at Geneva and New York, 500 individuals representing more than 250 NGOs attended. Recommendations were made and NGO strategy suggested [19, 20].

A number of international NGOs held special meetings devoted to the Special Session, often bringing together members from several continents. These included the World Council of Churches, the World Assembly of Youth, and the World Peace Council. Out of these various international meetings, a sheaf of NGO literature on the Special Session was published. Quite apart from those arising out of the several NGO conferences involving diplomats, pamphlets were issued by such groups as Operation Turning Point and the World Conference on Religion and Peace (WCRP).[2]

An even greater number of national NGO activities were held in preparation for the Special Session. These involved, in the first instance, educating the leadership of the individual organizations and, secondly, relating this learning to national disarmament policies.

NGOs in several countries were successful in urging governments to schedule meetings or hearings on their policies for the Special Session. For example, the Canadian and British governments held such meetings. In March 1978, the US State Department was host to a hearing for 300 US NGOs. In addition, national NGO conferences were held in Canada, the UK, Sweden, Australia, New Zealand and the USA.

The NGO Committee on Disarmament (at UN Headquarters) published *SSD News*, a modest newsletter indicating the depth and breadth of NGO activity related to the Special Session in various parts of the world. Also the first issue of the new periodical of the UN Centre for Disarmament, *Disarmament*, reflected some of this NGO activity [23].

During the third session of the Preparatory Committee, the question arose about the role of NGOs at the Special Session itself. The Preparatory Committee had to make recommendations to the Special Session. The UK asked the Secretariat to prepare a Conference Room Paper on the role of NGOs [24]. This dealt with a spectrum of NGO relations, including those at UN-related conferences. The UK then suggested that the Special Session be requested to extend the same facilities to NGOs as were available to them in the Preparatory Committee. This plea found immediate support and the Preparatory Committee recommended to the General Assembly that "non-governmental organizations concerned with disarmament should be accorded the same facilities at the Special Session as those which they have received at the preparatory committee" [25].

[2] WCRP published a series of 15 reports covering all five sessions of the Preparatory Committee. See also references [21, 22].

Preparations for NGO Day

During the fourth and fifth sessions of the Preparatory Committee, early in 1978, an enlarged role for NGOs during the Special Session emerged. Seventeen member states spoke in favour of allowing oral presentations by NGOs. NGOs were asked to decide among themselves which of the dozens of NGOs should appoint speakers and how many. A final recommendation on this subject would be made by the Preparatory Committee at its final session in April.

NGOs immediately tried to make the most of the opportunity. CONGO appointed a group of 12 international NGOs to attempt to produce a list of organizations to nominate speakers, should the Committee vote for oral presentations. Representatives of these 12 organizations, meeting simultaneously in Geneva and New York, could agree on only 18 organizations to make presentations.

When the Preparatory Committee resumed, it agreed by consensus to invite up to 25 NGOs to speak to the Ad Hoc Committee on 12 June. The actual list of NGOs and also of research institutes would be confirmed at a meeting of the Ad Hoc Committee on 1 June [26]. At this meeting seven NGOs were added to the previous list, three of national character, and it was also arranged that six research institutions would speak on the next day [27, 28].

Confirmation of NGO involvement

At the opening plenary meeting of the Special Session, the report of the Preparatory Committee was approved by consensus. This included the recommendation that a continuing role be given to NGOs. Thus the multiple arrangements which were evolved for NGOs during the four sessions of the smaller Preparatory Committee were continued in the Special Session itself.

Early in 1978, national, regional and international NGOs began to correspond with the UN Secretariat concerning attendance at the Special Session. The Secretariat set up an informal Register, accepting any NGOs expressing interest in the Special Session whether or not they had been previously related to the UN. A total of 237 organizations and institutions expressed an advance intention to be represented. In addition, a special group of 502 Japanese, representing 200 organizations, attended for one week. The UN Centre estimated that, on a rotating basis, a total of approximately 1 300 individuals representing some 430 organizations and institutions were actively involved at one point or another [29].

In anticipation of the role for NGOs, an inter-departmental group was set up within the UN Secretariat to work out details of NGO involvement. Registration procedures were established, initially at the NGO-operated Disarmament Information Bureau, and then inside the UN Headquarters. UN documentation on the Special Session was promptly made available to NGOs. Documentation by NGOs for delegations totalled several hundred different pieces in several languages. Materials not previously submitted to the Preparatory Committee were indexed by the Secretariat and circulated to delegates [30].

Daily briefings for NGOs, arranged by the UN Centre for Disarmament and the Office of Public Information, were attended by 50–150 NGOs. In addition to a daily description from a member of the Centre for Disarmament on what the delegates were doing in their various working and contact groups, a member of the Secretariat or a key delegation addressed the group and answered questions on a substantive disarmament issue. These briefings were so popular that they were continued on a monthly basis in the autumn of 1978.

A further dimension of NGO activity—a function of member states and not of the UN—was the appointment of NGOs to the official delegations of several member states. NGOs were appointed at least from Canada, Norway, Sweden, the UK and the USA.

A few NGOs played a 'lobby' role on specific issues, including efforts to insert desirable wording on a future role for NGOs in the Final Document (for text, see Appendix 11A). With many NGOs present inexperienced in UN affairs, and with delegates intensely negotiating because of time restrictions, perhaps the consultative role of NGOs was not as extensive or productive as expected.

NGO Day

NGO Day was held on 12 June, when speakers were heard from the following organizations: the Afro–Asian Peoples' Solidarity Organization, the Asian Buddhist Conference for Peace, the Commission of the Churches on International Affairs of the World Council of Churches, the Friends World Committee for Consultation, the Gandhi Peace Foundation, the International Association for Religious Freedom, the International Cooperative Alliance, the International Fellowship of Reconciliation, the International Peace Bureau, the International Youth and Student Movement for the United Nations, the Liaison Conference of Japanese National NGOs at the Special Session of the General Assembly Devoted to Disarmament, the Organization of Traditional Religions of Africa, Pugwash Conferences on Science and World Affairs, Socialist International, the Women's International Democratic Federation, the Women's International League for Peace and Freedom, the World Association of World Federalists, the World Conference on Religion and Peace, the World Federation of Democratic Youth, the World Federation of Scientific Workers, the World Federation of UN Associations, the World Peace Council, the World Union of Catholic Women's Organizations, the World Veterans Foundation, and the Yugoslav League for Peace, Interdependence and Equality of Peoples.

Six research institutes were heard the next day: the Institute for World Economics and International Relations, Academy of Sciences of the USSR, Moscow; the Center for Defense Information, Washington; the International Institute for Peace, Vienna; the International Peace Research Association; the Stanley Foundation, Iowa; and the Stockholm International Peace Research Institute.

The meeting was opened with the assertion that "disarmament is not the province of governments alone". It was hoped that, "far from arousing political confrontations", NGOs would be "a positive factor in cementing a climate of confidence and understanding on the basis of which it will be possible only to make real progress to curb the arms race".[3]

At the concluding session, the association of NGOs with the work of the General Assembly was considered fully justified and likely to mark the beginning of a new stage in the work of the UN in the field of disarmament. Excerpts from the NGO contributions [27, 29] and full texts [31, 32] have been separately published.

Informal activities of NGOs

At some of the UN conferences in the 1970s, the NGO community intentionally planned parallel conferences or tribunes for NGOs. These were held, for example, at the UN Conference on the Human Environment, Stockholm 1972; the UN World Population Conference, Bucharest 1974; and the UN Conference of the International Women's Year, Mexico City 1975. There are many advantages to such a parallel event, but one drawback: it tends to deflect the focus from the diplomatic conference to the secondary event. After careful consideration, and for several reasons, the NGO Committee on Disarmament decided six months in advance not to attempt to convene a parallel conference. Instead, it decided to sponsor two auxiliary events—the Disarmament Information Bureau and *Disarmament Times*—and encourage individual organizations, or groups of organizations, to sponsor their own informal events. This was no abdication of responsibility. Indeed, the

[3] Ambassador Carlos Ortiz de Rozas of Argentina, Chairman of the Committee, opening speech.

NGO Committee enlarged its leadership, convened regularly an enlarged Bureau, raised more than $54 000, and involved more than 100 persons actively in these informal activities.

The Special Session was a focus for many rallies and vigils. The Mobilization for Survival staged a march to the UN on 27 May, with more than 20 000 persons participating and hearing speeches at Dag. Hammarskjold Plaza. It also sponsored a non-violent sit-in around the Permanent Mission of the USA on 12 June. Religious groups marched to UN Headquarters. A daily vigil was held in front of the Isaiah Wall, sponsored by the Catholic Workers and the Fellowship of Reconciliation.

Education programmes on disarmament were also held involving a wide range of speakers and featuring both orthodox and unorthodox approaches to disarmament. Several groups convened meetings of their organizations in New York so that delegates could also attend the Special Session.

An NGO daily newspaper, *Disarmament Times*, was produced throughout the Special Session. This is not new—several UN-related world conferences in the 1970s have witnessed NGO-sponsored newspapers. *Disarmament Times* ran to 31 issues and some 5 000 copies of each issue were published. It was considered by the UN Secretary-General to be an important source of information and opinion for the delegates, Secretariat, press and NGOs involved in the Special Session.

Evaluation of the Special Session

A few NGOs made their own evaluation of NGO activity at the Special Session. They concluded that they did not prepare far enough in advance, especially in dialogues with their own governments. Too few NGOs took advantage of the opportunities open to them, both at the Preparatory Committee and at the Special Session itself.

Whether or not the NGO community made the correct decision not to convene an alternate conference is open to question. The Special Session inevitably attracted a number of individuals, only a few of whom represented organizations, who felt that they had to be present at this largest disarmament conference ever. Some wanted to submit or try to submit their formulae for world peace and disarmament. Few received any hearing. The question remains as to how such persons can be given a hearing and made to feel part of such a world event in the future.

The Secretariat and some of the diplomats also evaluated the role played by NGOs at the Special Session. It was felt that participation by NGOs had stimulated debate and reflected the constructive role which public opinion can play in many countries. Hopes were expressed that wider and more active involvement on the part of the NGOs and of the public would continue to make a valuable contribution in the future. In particular it was hoped that at the next Special Session, the composition of delegations of the NGOs would reflect wider representation from Third World countries.

Paragraph 123 and beyond

Although the role of NGOs at the Special Session was intensive, this was not clear from the Final Document. While some wording appeared early in the provisional text on the need for NGOs to help spread information about disarmament, it was more difficult to insert wording on a liaison function if not a strictly consultative one.

Sweden took the initiative to introduce an amendment on NGOs during negotiations on the Final Document. This was modified, in particular through negotiations with the leadership of the non-aligned group. In the end, the last two sentences of paragraph 123 in the Final Document provided for the potential institutionalization of the NGO role: "The [UN] Centre [for Disarmament] should also increase contact with non-governmental organizations and research institutions in view of the valuable role they play in the field of disarmament. This role could be encouraged also in other ways that may be considered as appropriate." Mention of NGOs also appeared in several other paragraphs, especially 100 and 104 (preparation and distribution of materials) and 106 (developing programmes for disarmament and peace studies.

At the 33rd regular session of the UN General Assembly, held in September/December 1978, the 150 member states reviewed the work of the Special Session and began to implement its Final Document. Among the record number (42) of disarmament resolutions and decisions adopted, one partly referred to NGOs [33]. Again, the insertion of a liaison role was not automatic. The final version was reached after considerable negotiations, involving Venezuela and Mexico. The key sentence requested the UN Centre "to increase contacts with non-governmental organizations and research institutions, in accordance with paragraph 123 of the Final Document and, after appropriate consultations, to report to the General Assembly at its thirty-fourth session on other ways of encouraging the role of such organizations and institutions in the field of disarmament".

Insufficient time has elapsed since the Special Session, or since the 33rd regular session, for paragraph 123 and others in the Final Document pertaining to NGOs to be implemented. However, even during the Special Session, a working party of NGOs formulated some guidelines related to paragraph 123, along the lines of the role of NGOs at the Special Session itself. The two NGO committees have also begun to draft guidelines relating to this opportunity. It is hoped that, early in 1979, the two committees might agree on a single draft outline to present to the UN Centre so that, well before the next General Assembly, several roles of NGOs in the field of disarmament may be regularized.

In the meantime, a total of nine NGOs were present at the first session of the Preparatory Committee for the UN Conference on Prohibitions or Restrictions of Use of Certain Conventional Weapons which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects, Geneva, September 1978 [34].

NGOs observed the first session of the new UN Disarmament Commission which met at Headquarters in October 1978. They also attended the meetings of the First Committee of the 33rd General Assembly. It is to be hoped that the more formal roles of NGOs at these and other disarmament deliberative and negotiating bodies will be strengthened.

III. NGOs and the evolution of an international movement

Disarmament Week

Paragraph 102 of the Final Document proclaims "a week starting 24 October, the day of the foundation of the UN, as a week devoted to fostering the objectives of disarmament". Some delegations felt that there were better ways to educate, world-wide, for an end to the arms race and others wanted the anniversary of the bombing of Hiroshima and Nagasaki, 6 and 9 August, to be observed as disarmament days. In a last-minute compromise the week of 24 October was chosen. The first observance of the week, in 1978, was understandably uneven, with few governments or NGOs having had sufficient notice. Better planning for observance of Disarmament Week was called for by the General Assembly.

A disarmament movement?

Although clearly valuable in itself, NGO participation in the Special Session demonstrated the lack of an independent, international disarmament movement as well as independent national disarmament movements in key countries. During the Special Session, and afterwards, some NGOs began the background work necessary to attempt to create an independent international movement for disarmament.

International, world-wide movements have developed on other global issues, for example, in the fields of environment, population, food and women's rights. NGO campaigns in some of these fields have helped focus UN attention and resulted in a series of world conferences in the 1970s; other world-wide campaigns grew out of such conferences. In the field of disarmament, the effort to ban nuclear weapon tests in the late 1950s was world-wide and impressive.

The creation of an international movement—if one can be consciously created—appears to include at least some of the following stages.

First is the setting of objectives and the conceptualization. Many who observed the UN Special Session realized that much more effort, international and non-governmental, was needed. The goal to create an international disarmament movement became obvious. Efforts to conceptualize a movement started during the Special Session itself. Groups in several countries are already undertaking the necessary background work for such a movement. In some countries, this effort is necessarily linked with the creation of national disarmament movements which need the stimulus of an international movement. In turn, an international movement is academic without strong national movements.

After conceptualization comes communication. There is no obvious means of communication, certainly no existing international peace newspaper or other periodical. *Peace News* of London performed this task admirably in the late 1950s and early 1960s. *Disarmament Times* at the UN Special Session did so for five weeks for its limited number of readers. It will certainly be of value if some such information service can continue in future.

The third stage is the identification of the existing organizations in the field, their perceived roles and their actual programmes. A tentative 'map' of some US organizations working for disarmament has been put together by one group of planners.[4] This needs to be done on an international scale. No comprehensive international directory of disarmament organizations exists. If it did, it would show a remarkable range of local, national, regional and international organizations working in the field of disarmament. Some are general, all-purpose organizations; others specialize, some limiting themselves to the field of disarmament. Some are disarmament research institutions; others are more general

[4] The Institute for World Order.

peace or international relations research organizations. Many are educational. Some are activist, specializing in 'street activity' and rallies and demonstrations. Some are lobbies. A few are unique. Some necessary tasks seem not performed by any existing organization, although a more methodical evaluation of them all is needed.

A fourth stage in the evolution of an international disarmament movement is for the leadership of some of the existing international and national organizations to come together for exploratory purposes. Crucial questions arise of who is to call them together, which groups should be invited, how balance may be ensured and how political or ideological domination can be prevented. Some previous efforts have foundered due to lack of balance. The incipient movement was skewed in one or another ideological direction.

A fifth stage is funding. Although huge amounts are spent on military endeavours (see chapter 1), private organizations are spending much less each year on disarmament research and education. Such a movement needs money—and money given without political strings.

A sixth and perhaps final stage is substantive. What issues or programmes can unite organizations from diverse regions and social systems? Can a common, international campaign, if successful, become a coalition? And can a successful coalition become a movement? There must be political wisdom in selecting the specific, time-bound issues as well as the broader, more distant goals.[5]

References

1. Lind, C., *NGO Activity at the League of Nations Disarmament Conference (1932)*, (NGO Committee on Disarmament at UN Headquarters, New York).
2. UN General Assembly Resolution 2092 (XX).
3. UN General Assembly Resolution 3472 (XXX).
4. UN General Assembly Resolution 2825 (XXVI).
5. UN General Assembly Resolution 31/68.
6. *Final Report of the International NGO Conference on Disarmament* (International Peace Bureau, Geneva, 1972), p. 99.
7. Geyer, A., 'The nuclear question explodes',' *Worldview,* September 1975, pp. 27–32.
8. *Recommendations prepared by an International Conference* (Bradford Proposals), (International Peace Bureau, Geneva, 1975), p. 4.
9. UN General Assembly Resolution 3483 (XXX).
10. *Strengthening the Role of International Non-Governmental*

[5] For other preliminary discussions of an international disarmament movement, see references [33, 44, 45].

Organizations (NGOs) in the Field of Disarmament (NGO Committee on Disarmament, United Nations, New York, 24 June 1976), p. 2.
11. UN Official Records: 31st Session, Supplement No. 36 (A/31/36).
12. UN General Assembly Resolution 31/189B.
13. *UN Special Session on Disarmament,* Report of the Eighth Annual Conference on UN Procedures (Stanley Foundation, Muscatine, Iowa, 1977), pp. 32–37.
14. UN document A/AC.187/SR.4.
15. UN document A/AC.187/INF.2–7.
16. UN document A/INF/S-10/1.
17. *Opportunities for Disarmament: A Preview of the 1978 United Nations Special Session on Disarmament,* ed. J.M.O. Sharp (Carnegie Endowment for International Peace, New York, 1978), p. 146.
18. *Regional Colloquium on Disarmament and Arms Control* (Oxford and IBH Publishing Co., New Delhi, 1978), p. 88.
19. *International NGO Conference on Disarmament,* Final Report (Geneva, 1977), p. 16.
20. *Disarmament: A Periodic Review by the UN,* Vol. 1, No. 1, May 1978, pp. 51–56.
21. *Sheaf of Documents: Preliminary Materials for the Special Sesison* (World Conference on Religion and Peace, New York, 1977), p. 16.
22. *A Citizen's Guide to the UN Special Session on Disarmament* (World Conference on Religion and Peace, New York, 1977), p. 23.
23. 'The NGOs and the Special Session', *Disarmament,* Vol. 1, No. 1, pp. 56–60.
24. UN Special Session on Disarmament, 1978, Conference Room Paper No. 4.
25. UN Official Records: 32nd Session, Supplement No. 41, paragraph 11, p. 9 (A/32/41).
26. UN document A/S-10-1.
27. Jack, H.A., *Disarmament Workbook: The UN Special Session and Beyond* (World Conference on Religion and Peace, New York, 1978), pp. 102–103.
28. Hollister, B., 'NGO Day—how it all began', *Disarmament Times,* 12 June, 1978.
29. *Disarmament,* Vol. 1, No. 2, pp. 76–77.
30. UN document A/INF/A-10/1.
31. UN document A/S-10/AC.1/PV.6–7.
32. UN document A/S-10/AC.1/PV.8.
33. UN General Assembly Resolution 33/71G.
34. UN Official Records: 33rd Session, Supplement No. 44 (A/33/44).
35. Jack, H.A., 'An international disarmament movement?' *Bulletin of Peace Proposals,* Vol. 9, No. 3, 1978, pp. 234–38.
36. Washburn, M., and Weyerhaeuser, S., *The Peace Movement in 1978: Where are We, Who are We, and Where are We Going?'* (Institute for World Order, New York, 1978), p. 23.

19. Chronology of major events concerning disarmament issues

January – December 1978

6 January At a meeting with a group of US Senators in New Delhi, the Indian Prime Minister states that before India could agree to sign the Non-Proliferation Treaty, it is necessary that the nuclear weapon powers should first give up all nuclear tests and explosions, stop making any new additions to, and give an undertaking to destroy, their nuclear weapon stockpiles in a few years time.

11 January The members of the Nuclear Supplier Group (the so-called London Club) address communications to the Director-General of the International Atomic Energy Agency (IAEA), containing agreed guidelines for nuclear transfers.

12 January At a press conference held in New Delhi, the Indian Prime Minister reiterates the position of India that it will not accede to full-scope nuclear safeguards unless the other nuclear powers, or at least the USA and the USSR, sign a comprehensive test-ban treaty, agree to desist from the manufacture of new nuclear weapons and decide on a phased reduction and eventual elimination of their existing nuclear weapon stockpiles.

27 February–2 March An international conference of non-governmental organizations is held in Geneva to discuss preparations for the UN Special Session on Disarmament.

9 March The delegation of the USSR at the Conference of the Committee on Disarmament submits, together with the delegations of Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland and Romania, a draft convention on the prohibition of the production, stockpiling, deployment and use of neutron weapons.

9 March A meeting held in Belgrade to review progress in implementing the provisions of the 1975 Final Act of the Conference on Security and Co-operation in Europe, ends with the adoption of a Concluding Document. It is decided that the next meeting will take place in Madrid in 1980.

10 March The President of the USA signs the Nuclear Non-Proliferation

Act intended to ensure a halt in the spread of nuclear weapon capability while maintaining the peaceful use of nuclear energy.

17 March In a speech delivered at Wake Forest University, North Carolina, the US President states that reaching balanced, verifiable agreements with adversaries can limit the cost of US security and reduce the risk of war, but even then, the USA must and will proceed efficiently with whatever arms programmes are required for its own security.

7 April The President of the USA announces that the production of neutron weapons will be deferred, and that the ultimate decision will be made later and will be influenced by a degree to which the USSR shows restraint in its conventional and nuclear arms programmes and force deployments affecting the security of the USA and Western Europe.

19 April At the Vienna talks on the reduction of forces in Central Europe, the NATO countries propose that the USA withdraw 1 000 tactical nuclear warheads, 54 F-4 aircraft with nuclear capability, 36 Pershing medium-range missiles and 29 000 troops from Europe in the first stage of force reductions in return for a Soviet withdrawal of 68 000 men and 1 700 tanks from the German Democratic Republic, Czechoslovakia and Poland.

24–25 April The Ministers of Foreign Affairs of the Warsaw Treaty Member States, meeting in Sofia, call for a speedy adoption of effective steps directed at lessening military confrontation, facilitating disarmament and strengthening trust in Europe.

25 April In a statement made at the Congress of the Soviet Communist Youth League, the Chairman of the Presidium of the Supreme Soviet of the USSR states that the Soviet Union will not start the production of neutron weapons unless the USA does so. He urges consideration of a programme for the implementation of the following measures within a fixed time-limit: cessation of the production of nuclear weapons of all types; cessation of the production of, and a prohibition on, all other types of weapons of mass destruction; cessation of the development of new types of conventional weapons of great destructive force; and abstention from expanding the armies and increasing the quantity of conventional weapons of the permanent members of the Security Council and of the countries associated with them under military agreements. He also states that only an aggression against the USSR or its allies by another nuclear power could compel the Soviet Union to have recourse to the use of nuclear weapons.

6 May In a joint declaration issued in Bonn, the USSR and the Federal

Republic of Germany state that no one should seek military superiority and that approximate equality and parity are sufficient to insure defence. They reiterate that the aim of the Vienna talks is to achieve a more stable situation with lower military levels than today, and they pledge that they will be ready to reduce their armed forces on terms to be determined in Vienna.

18 May The USSR signs Additional Protocol II of the Treaty of Tlatelolco prohibiting nuclear weapons in Latin America. It thereby undertakes to respect the statute of military denuclearization in Latin America and not to contribute to acts involving a violation of the Treaty, nor to use or threaten to use nuclear weapons against the parties to the Treaty.

20 May The President of the USA signs a memorandum directing US negotiators to seek a five-year nuclear test ban.

23 May–1 July The UN General Assembly holds a special session devoted to disarmament.

26 May Addressing the UN Special Session on Disarmament the Soviet Foreign Minister declares that the USSR will never use nuclear weapons against those states which have renounced the production and acquisition of such weapons and which do not have them on their territories.

8 June At the Vienna talks on the reduction of forces in Europe, the Warsaw Treaty countries accept the NATO concept of a common ceiling of 900 000 men, including 700 000 ground forces, for each side, stationed in the central region of Europe. They also express their willingness to carry out a selective reduction and limitation of armaments and equal proportional cuts in the Soviet and US forces stationed in that area.

8–16 June The USA and the USSR start talks on controlling anti-satellite systems.

9 June In a speech made at the UN Special Session on Disarmament, the Indian Prime Minister reiterates India's pledge not to manufacture or acquire nuclear weapons and not to conduct nuclear explosions even for peaceful purposes.

12 June The US President announces that the USA will not use nuclear weapons against any non-nuclear weapon state which is party to the Non-Proliferation Treaty or any comparable internationally binding agreement not to acquire nuclear explosive devices.

12–13 June Twenty-five non-governmental organizations and six research institutes (including SIPRI) address the *Ad Hoc* Committee of the UN Special Session on Disarmament.

28 June The British delegate to the UN Special Session on Disarmament states that the UK undertakes not to use nuclear weapons against non-nuclear weapon states which are parties to the Non-Proliferation Treaty or to other internationally binding commitments not to manufacture or acquire nuclear explosive devices.

1 July The UN Special Session on Disarmament adopts a Final Document which contains a declaration, a programme of action and a section on the international machinery dealing with disarmament.

9 August France decides to renegotiate its agreement with Pakistan for the supply of a nuclear reprocessing plant.

5 October The Convention on the prohibition of military or any other hostile use of environmental modification techniques enters into force.

9–13 October The Disarmament Commission, established by the UN Special Session on Disarmament, meets to consider the organization of its work.

31 October–11 December Following a recommendation contained in the Concluding Document of the Belgrade meeting of the Conference on Security and Co-operation in Europe, a meeting of experts is held at Montreux, Switzerland, to discuss the peaceful settlement of disputes.

23 November In a declaration adopted at the Conference of the Political Consultative Committee of the Warsaw Treaty, the member states call for early negotiations among the five nuclear weapon powers to remove nuclear weapons of all types from the arsenals of states and to turn nuclear energy to peaceful uses only; the reduction of the military budgets of the countries with considerable military and economic potential; the implementation of the recommendations of the UN Special Session on Disarmament; and the reduction of the level of military confrontation on the European continent.

27–29 November The first plenary conference of INFCE (International Nuclear Fuel Cycle Evaluation) is held in Vienna. The purpose of INFCE is to explore measures minimizing the danger of nuclear-weapon proliferation without jeopardizing the development of nuclear energy for peaceful purposes.

7 December The Protocols additional to the Geneva Conventions of 12 August 1949, and relating to the protection of victims of international and non-international armed conflicts, enter into force.

8 December The North Atlantic Council, meeting in ministerial session in Brussels, welcomes the increasing world-wide attention paid to arms control and disarmament; notes that an exchange of views has taken place on the French proposal for a conference on disarmament in Europe and on the prospects that this proposal might offer for confidence-building and security in the area; welcomes the progress made in the US–Soviet strategic arms limitation talks; reaffirms the commitment to the negotiations on force reductions in Europe and the determination to bring them to a successful conclusion; and welcomes the movement of the Warsaw Treaty countries towards agreement on the concept of approximate parity.

14–16 December The 33rd UN General Assembly adopts over 40 resolutions on disarmament issues.

Errata

World Armaments and Disarmament, SIPRI Yearbook 1978

Page 80, lines 8–9.	Read "a West German firm, signed with the Zaire government" for " . . . signed with the West German government".
Page 260, line 2.	Delete supply of A-4P Skyhawk by Argentina to Chile; no deal was concluded.
Page 274.	By "recipient: Rhodesia", give supplier countries (France), (UK) and (USA) within parentheses since these three are only countries of origin of illegal sales, which are therefore not included in the SIPRI statistics.
Page 277.	By "recipient: Taiwan", seller of the Gabriel-2 should read "Israel" rather than "USSR".
Page 438, Table 15.3.	Read "Poseidon C-3" for Poseidon C-4". Read "Polaris A-3" for "Polaris C-3".
Pages 442–443, Figure 15.8.	Read "Poseidon C-4" for "Trident D-5". Read "Range *(nautical miles)*" for "Range *(km)*".
Page 444, Table 15.5.	Read "Poseidon C-3 and C-4" for "Poseidon C-4".

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Page numbers in italics refer to tables and figures.

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