World Armaments and Disarmament

SIPRI yearbook 1982

Stockholm International Peace Research Institute

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Stockholm International Peace Research Institute

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PREFACE

This book, the thirteenth Yearbook of World Armaments and Disarmament, is published rather earlier in the year than usual, so that it can be available for the United Nations Second Special Session on Disarmament.

The objective remains the same: to provide well-researched information on what is happening in the world's military sector, and to describe the progress (if any) in attempts at restraint. The book covers events up to the end of 1981—though in some instances material made available in January 1982 is included.

This Yearbook gives special attention to European issues, with chapters on long-range theatre nuclear forces in Europe, and on the Nordic proposals for a nuclear weapon-free zone. There are the usual reports on world military expenditure, on arms production, on strategic nuclear weapons, on nuclear weapon tests, on the military use of satellites, and on the arms trade. There is a chapter on the neutron bomb; a study of developments in chemical and biological warfare; a regional study of militarization and arms control in Latin America; and a study of the environmental aftermath of warfare in Viet Nam. There are shorter notes —for instance, on one particular example of weapon development, the Maverick missile; and a note also on the problems posed, for the humanitarian rules of war, by small-calibre high-velocity rifle bullets.

The authors of the chapters are given in the Table of Contents. I am grateful to all who have worked on the book, both inside and outside SIPRI—and in particular to Connie Wall and Billie Bielckus, without whose editorial expertise the Yearbook would never appear on time.

Frank Blackaby
May 1982 *Director*

CONTENTS

Part I. European security

Part II. Developments in world armaments in 1981

Part IV. Developments in arms control in 1981

Figures for the Yearbook were prepared by Alberto Izquierdo.

ACRONYMS

ABM	Anti-ballistic missile
AGM	Air-to-ground missile
ALCM	Air-launched cruise missile
ASAT	Anti-satellite
ASBM	Air-to-surface ballistic missile
ASM	Air-to-surface missile
ASW	Anti-submarine warfare
AWACS	Airborne warning and control system
BMD	Ballistic missile defence
BW	Biological weapon
CBM	Confidence-building measure
CBW	Chemical and biological warfare
CCD	Conference of the Committee on Disarmament
CD	Committee on Disarmament
CEP	Circular error probable
CSCE	Conference on Security and Co-operation in Europe
CTB	Comprehensive test ban
CW	Chemical weapon
ENDC	Eighteen-Nation Disarmament Committee
ENMOD	Environmental modification
ERW	Enhanced radiation weapon
FOBS	Fractional orbital bombardment system
GLCM	Ground-launched cruise missile
IAEA	International Atomic Energy Agency
ICBM	Intercontinental ballistic missile
INFCE	International Fuel Cycle Evaluation
IRBM	Intermediate-range ballistic missile
ISMA	International Satellite Monitoring Agency
LRTNF	Long-range theatre nuclear force
MAD	Mutual assured destruction
MARV	Manoeuvrable re-entry vehicle
M(B)FR	Mutual (balanced) force reduction
MIRV	Multiple independently targetable re-entry vehicle
MRV	Multiple (but not independently targetable) re-entry vehicle
MURFAAMCE	Mutual reduction of forces and armaments and associated measures in Central Europe
NPT	Non-Proliferation Treaty
NWFZ	Nuclear weapon-free zone
OPANAL	Agency for the Prohibition of Nuclear Weapons in Latin America
PNE(T)	Peaceful Nuclear Explosions (Treaty)
PTB(T)	Partial Test Ban (Treaty)
RV	Re-entry vehicle
RW	Radiological weapon
SALT	Strategic Arms Limitation Talks
SAM	Surface-to-air missile
SCC	Standing Consultative Commission (US–Soviet)
SLBM	Submarine-launched ballistic missile
SLCM	Sea-launched cruise missile
SRBM	Short-range ballistic missile
TTBT	Threshold Test Ban Treaty

GLOSSARY

Anti-ballistic missile (ABM) system	Weapon system for intercepting and destroying ballistic missiles.
Anti-satellite (ASAT) system	Weapon system for destroying, damaging or disturbing the normal function of, or changing the flight trajectory of, artificial Earth satellites.
Ballistic missile	Missile which follows a ballistic trajectory (part of which is outside the Earth's atmosphere) when thrust is terminated.
Battlefield nuclear weapons	*See:* Theatre nuclear weapons.
Binary chemical weapon	A shell or other device filled with two chemicals of relatively low toxicity which mix and react while the device is being delivered to the target, the reaction product being a supertoxic chemical warfare agent, such as nerve gas.
Biological weapons (BW)	Living organisms or infective material derived from them, which are intended for use in warfare to cause disease or death in man, animals or plants, and the means of their delivery.
Chemical weapons (CW)	Chemical substances—whether gaseous, liquid or solid—which might be employed as weapons in combat because of their direct toxic effects on man, animals or plants, and the means of their delivery.
Circular error probability (CEP)	A measure of missile accuracy: the radius of a circle, centred on the target, within which 50 per cent of the weapons aimed at the target are expected to fall.
Committee on Disarmament (CD)	Multilateral arms control negotiating body, based in Geneva, which is composed of 40 states (including all the nuclear weapon powers). The CD is the successor of the Eighteen-Nation Disarmament Committee, ENDC (1962–69), and the Conference of the Committee on Disarmament, CCD (1969–78).
Conventional weapons	Weapons not having mass destruction effects. *See also:* Weapons of mass destruction.
Counterforce attack	Attack directed against military targets.
Countervalue attack	Attack directed against civilian targets.
Cruise missile	Missile which can fly at very low altitudes (and can be programmed to follow the contours of the terrain) to minimize radar detection. It can be air-, ground- or sea-launched and carry a conventional or a nuclear warhead.
Enhanced radiation weapon (ERW)	*See:* Neutron weapon.
Enriched nuclear fuel	Nuclear fuel containing more than the natural contents of fissile isotopes.
Enrichment	*See:* Uranium enrichment.
Eurostrategic weapons	*See:* Theatre nuclear weapons.
Fall-out	Particles contaminated with radioactive material as well as radioactive nuclides, descending to the Earth's surface following a nuclear explosion.

First-strike capability	Capability to destroy within a very short period of time all or a very substantial portion of an adversary's strategic nuclear forces.
Fission	Process whereby the nucleus of a heavy atom splits into lighter nuclei with the release of substantial amounts of energy. At present the most important fissionable materials are uranium-235 and plutonium-239.
Flexible response capability	Capability to react to an attack with a full range of military options, including a limited use of nuclear weapons.
Fractional orbital bombardment system (FOBS)	System capable of launching nuclear weapons into orbit and bringing them back to Earth before a full orbit is completed.
Fuel cycle	*See:* Nuclear fuel cycle.
Fusion	Process whereby light atoms, especially those of the isotopes of hydrogen—deuterium and tritium—combine to form a heavy atom with the release of very substantial amounts of energy.
Genocide	Commission of acts intended to destroy, in whole or in part, a national, ethnical, racial or religious group.
Intercontinental ballistic missile (ICBM)	Ballistic missile with a range in excess of 5 500 km.
Intermediate-range nuclear weapons	US designation for long-range and possibly medium-range theatre nuclear weapons. *See also:* Theatre nuclear weapons.
International Nuclear Fuel Cycle Evaluation (INFCE)	International study conducted in 1978–80 on ways in which supplies of nuclear material, equipment and technology and fuel cycle services can be assured in accordance with non-proliferation considerations.
Kiloton (kt)	Measure of the explosive yield of a nuclear weapon equivalent to 1000 metric tons of trinitrotoluene (TNT) high explosive. (The bomb detonated at Hiroshima in World War II had a yield of about 12–15 kilotons.)
Launcher	Equipment which launches a missile. ICBM launchers are land-based launchers which can be either fixed or mobile. SLBM launchers are missile tubes on submarines.
Manoeuvrable re-entry vehicle (MARV)	Re-entry vehicle whose flight can be adjusted so that it may evade ballistic missile defences and/or acquire increased accuracy.
Medium-range nuclear weapons	Soviet designation for long-range theatre nuclear weapons. *See also:* Theatre nuclear weapons.
Megaton (Mt)	Measure of the explosive yield of a nuclear weapon equivalent to one million metric tons of trinitrotoluene (TNT) high explosive.
Multiple independently targetable re-entry vehicles (MIRV)	Re-entry vehicles, carried by one missile, which can be directed to separate targets.
Mutual assured destruction (MAD)	Concept of reciprocal deterrence which rests on the ability of the nuclear weapon powers to inflict intolerable damage on one another after surviving a nuclear first strike.

Mutual reduction of forces and armaments and associated measures in Central Europe (MURFAAMCE)	Subject of negotiations between NATO and the Warsaw Treaty Organization, which began in Vienna in 1973. Often referred to as mutual (balanced) force reduction (M(B)FR).
Neutron weapon	Nuclear explosive device designed to maximize radiation effects and reduce blast and thermal effects.
Nuclear fuel cycle	Series of steps involved in preparation, use and disposal of fuel for nuclear power reactors. It includes uranium ore mining, ore refining (and possibly enrichment), fabrication of fuel elements and their use in a reactor, reprocessing of spent fuel, refabricating the recovered fissile material into new fuel elements and disposal of waste products.
Nuclear weapon	Device which is capable of releasing nuclear energy in an explosive manner and which has a group of characteristics that are appropriate for use for warlike purposes.
Nuclear weapon-free zone (NWFZ)	Zone which a group of states may establish by a treaty whereby the statute of total absence of nuclear weapons to which the zone shall be subject is defined, and a system of verification and control is set up to guarantee compliance.
Peaceful nuclear explosion (PNE)	Application of a nuclear explosion for such purposes as digging canals or harbours, creating underground cavities, etc.
Plutonium separation	Reprocessing of spent reactor fuel to separate plutonium.
Radiological weapon (RW)	Device, including any weapon or equipment, other than a nuclear explosive device, specifically designed to employ radioactive material by disseminating it to cause destruction, damage or injury by means of the radiation produced by the decay of such material, as well as radioactive material, other than that produced by a nuclear explosive device, specifically designed for such use.
Re-entry vehicle (RV)	Portion oı a strategic ballistic missile designed to carry a nuclear warhead and to re-enter the Earth's atmosphere in the terminal phase of the trajectory.
Second-strike capability	Ability to survive a nuclear attack and launch a retaliatory blow large enough to inflict intolerable damage on the opponent. *See also:* Mutual assured destruction.
Standing Consultative Commission (SCC)	US–Soviet consultative body established in accordance with the SALT agreements.
Strategic Arms Limitation Talks (SALT)	Negotiations between the Soviet Union and the United States, initiated in 1969, which seek to limit the strategic nuclear forces, both offensive and defensive, of both sides.
Strategic nuclear forces	ICBMs, SLBMs, ASBMs and bomber aircraft of intercontinental range.
Tactical nuclear weapons	*See:* Theatre nuclear weapons.
Terminal guidance	Guidance provided in the final, near-target phase of the flight of a missile.

Theatre nuclear weapons	Nuclear weapons of a range less than 5500km. Often divided into long-range—over 1000km (for instance, so-called Eurostrategic weapons), medium-range, and short-range—up to 200km (also referred to as tactical or battlefield nuclear weapons).
Thermonuclear weapon	Nuclear weapon (also referred to as hydrogen weapon) in which the main part of the explosive energy released results from thermonuclear fusion reactions. The high temperatures required for such reactions are obtained with a fission explosion.
Toxins	Poisonous substances which are products of organisms but are inanimate and incapable of reproducing themselves. Some toxins may also be produced by chemical synthesis.
Uranium enrichment	The process of increasing the content of uranium-235 above that found in natural uranium, for use in reactors or nuclear explosives.
Warhead	That part of a missile, torpedo, rocket or other munition which contains the explosive or other material intended to inflict damage.
Weapons of mass destruction	Nuclear weapons and any other weapons which may produce comparable effects, such as chemical and biological weapons.
Weapon-grade material	Material with a sufficiently high concentration either of uranium-233, uranium-235 or plutonium-239 to make it suitable for a nuclear weapon.
Yield	Released nuclear explosive energy expressed as the equivalent of the energy produced by a given number of metric tons of trinitrotoluene (TNT) high explosive. *See also:* Kiloton and Megaton.

NOTE ON CONVENTIONS

The following general conventions are used in the tables:

.. Information not available

( ) Uncertain data or SIPRI estimate

– Nil or not applicable

'Billion' in all cases is used to mean thousand million.

Metric units generally apply. However, both short tons and metric tons are used and are specified where necessary. For convenience, the conversions are:

1 *metric* ton (tonne) = 1 000 kilograms = 2 205 pounds = 1.1 short tons

1 *short* ton = 2 000 pounds = 0.91 metric ton (tonne)

1 kiloton (kt) = 1 000 (metric) tons

1 megaton (Mt) = 1 000 000 (metric) tons

The dose of radiation is measured as the energy of the ionizing radiation absorbed in tissue. The unit of dose is the Gray (Gy); 1 gray = 1 joule per kilogram of tissue. Many publications still use the *rad* as the unit of dose (1 Gy = 100 rad).

Introduction

The purpose of this book—and of the summary in this introduction—is to review the state of world armaments and disarmament, in advance of the United Nations Second Special Session on Disarmament.

Obviously matters of armaments and disarmament are interconnected with international political events: consider, for example, the effect of the imposition of martial law in Poland on the discussions at Madrid. This book does not set out to cover political events of that kind—it would have to be double the size to do that. Developments in what has been called 'the world war industry' are proper subjects of study in their own right—the fact that there is a UN Special Session on Disarmament is evidence enough of that. Armaments are not simply the consequence of international tension: they are also a cause.

Since the First Special Session on Disarmament four years ago, things have got worse. Expenditure on military research and development is rising fast; the spread of modern weapons around the world continues unchecked. There is little impetus at the moment behind any moves for arms control, let alone disarmament. The pressure against the few arms control barriers which have been set up in the post-war period is getting stronger. It is a sign of the times that some people are beginning to talk of the present as a pre-war rather than a post-war period.

The hopeful sign is in growing public concern, particularly in some countries in both Western and Eastern Europe and particularly about nuclear weapons—a concern not simply about the nuclear weapons of one side only. Questions of disarmament are no longer matters of limited interest to a small circle. As a consequence, the major powers—in the negotiations at Geneva for example—are having to take public opinion into account. Both the US and Soviet Ministries of Defence have published popular books on the threat to peace presented by the other side. The need for unbiased information was never greater.

The short summary which follows has to be highly selective. It begins with world military expenditure, the production of conventional weapons, and the arms trade. It then looks at the growing arsenals of intercontinental nuclear weapons—and in this weapons section summarizes the material on the militarization of outer space, on the neutron bomb, and on chemical and biological warfare. The third section, on armaments and arms control, concentrates on the background to the negotiations at

Geneva, and presents some main points from a discussion of Nordic initiatives for a nuclear weapon-free zone.

I. World military expenditure, arms production and the arms trade

During the past four years, world military spending has been following an upward trend at a rate of about 3 per cent per annum (in volume). This is rather faster than in the previous four years, in spite of the deteriorating performance of the world economy. So the burden, measured as a share of the world's total output, has probably been rising. It is difficult to get a meaningful measure of the world total: for what it is worth, the current dollar figure in 1981 was about $600–650 billion.

There is no evidence of any particular change in trend in Soviet military spending: a steady rise continues. The Soviet Union outproduces the United States in its annual deliveries of a number of standard conventional weapons; that has been true for a long time. The technological lag, however, though it may be smaller than a decade ago, is still considerable, particularly in electronics. A military comparison must allow for the fact that European NATO countries have bigger military budgets than the other Warsaw Treaty Organization (WTO) countries, and that the Soviet Union also maintains a considerable military force along its border with China.

The Soviet Navy continues to improve its ocean-going capacity, with a number of new classes of ship which will give the Soviet Union a much greater peace-time 'power projection' capacity. This capacity is still inferior to that of the United States. On the other hand, the Soviet Union is much nearer than the United States to certain important existing and potential areas of confrontation—the Persian Gulf, the Middle East, Korea and Europe itself.

There has been a sharp change in trend in military spending in the United States. This already appears in the 1981 figures, where the estimated volume increase in military spending for the calendar year is 6 per cent. The new Administration's five-year plan is indeed to move military expenditure (actual outlays) on to an 8 per cent real growth path—that is, the average annual percentage change from now to 1987 implied by the figures in the 1983 budget request. This follows a substantial change in public attitudes: back in 1969, in a public opinion poll, only 8 per cent of respondents said that defence spending was too small. By 1980 the figure had risen to 49 per cent.

The rearmament programme includes a number of new strategic weapon systems (discussed in section II). Otherwise, the main objective is to increase the ability of the United States to project its power in parts of the world distant from the American continent. For the Navy, the aim is to reach a 600-ship Navy by 1987: that means the construction of 143 combat ships. For the Army and the Marines, heavy expenditure is envisaged for the Rapid Deployment Force (RDF). The decision has also been taken to resume production of chemical weapons, which had been stopped over a decade ago.

The main question mark over this programme is an economic one. If the programme is put into effect, military spending will increase its share of national output from 5.7 per cent in 1981 to 7 or 8 per cent in 1986, depending on whether there is a recovery in productivity. The future course of US military spending will, quite probably, be mainly determined by economic factors.

Whereas in the United States the trend in military expenditure has begun to accelerate, in other NATO countries (taken together) it has not. Since May 1977, when NATO countries collectively agreed to adopt an annual 3 per cent volume target increase, the rise in military spending in NATO countries other than the USA has been slightly slower than it was before. Most countries in Europe have been preoccupied with their budget deficits; finance ministers have won out over defence ministers. Many politicians saw no reason to think that the Soviet threat had suddenly become so acute as to require dramatic changes in their military spending.

The divergence between the United States and its NATO allies is likely to lead to stresses within the alliance. So, too, is the United States' development of weapons—the neutron bomb, and chemical munitions with binary agents—which only make sense if deployed in areas of possible confrontation such as Europe, but which the Europeans in general do not seem to want.

In the United Kingdom, there has been an upward change in trend—though even so a defence review has forced reductions in the Navy's surface fleet. The main source of public concern has been with the independent nuclear deterrent—first with an immensely expensive programme whose object was to try to ensure that Polaris warheads could penetrate possible future anti-ballistic-missile defences round Moscow; and secondly with the escalating cost of the future replacement of Polaris with the Trident system. In the Federal Republic of Germany military spending has not risen much in real terms, and there the major concern has been with the budget cost of the Tornado (the multi-role combat aircraft) programme; a series of upward revisions brought the 1981 cost of this programme up from DM 1 750 million to a figure of DM 3 065 million.

Japan has also been under pressure from the United States to increase its military budget, with the suggestion that it should take responsibility for defending the airspace and sea lanes up to 1 000 miles from its shores.

The suggestion has been met with a cool response. There is little public enthusiasm in Japan for more military spending. The article in the constitution which says that "land, sea and air forces, as well as other war potential, will never be maintained" still has some influence. Nevertheless, Japan ranks eighth in the world in its expenditure on Self-Defense Forces.

Military spending is moving up significantly in India and Pakistan, with substantial arms supplies from the Soviet Union and the United States respectively. After a long period of relative quiescence, Australia and New Zealand are also increasing their military budgets. This is a reaction to the general increase in world tension, rather than the perception of any new threat. The one major country where the change has been in the other direction is China. In 1981, the Chinese military budget was cut heavily. Top priority is at present being given to the improvement of the civil economy.

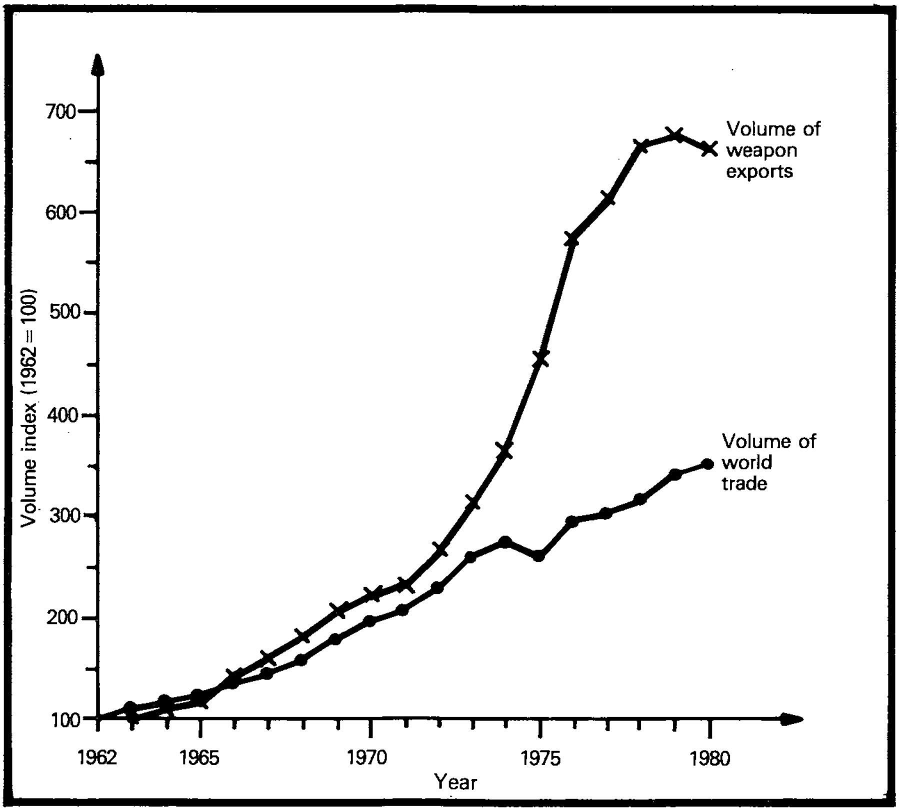
Arms trade

There is at present little prospect for any kind of restraint on the international trade in arms. The conventional arms transfer talks between the United States and the Soviet Union were adjourned three years ago, and have not been resumed; the European arms suppliers have shown no inclination towards restraint. International tension and economic pressure all make for bleak prospects for any restraint. The underlying trend—doubling in volume every five years—continues.

In the period 1979–81, the Soviet Union overtook the United States as the leading exporter of major weapons. This was partly because of a big increase in arms exports to India, and to countries in the Middle East and North Africa; the other reason was a decline in US exports resulting from the policy of restraint initiated by President Carter in 1977.

However, the Soviet Union still has a smaller number of customers than the United States: during 1981, it had arms deals with 28 countries, compared with 67 countries for the USA. The Soviet Union traditionally charges low prices, has favourable credit terms, and has been prepared to consider barter arrangements; however, more recently it has been looking for payment in hard currency. It is also exporting more modern equipment than before: for example, it is believed that the slow introduction of the T-72 main battle tank into service with the WTO armies is partly explained by large exports to Middle Eastern and North African countries. The Soviet Union is using arms transfers as an important instrument for maintaining and expanding its influence in the Third World. Arms transfers play a far greater role than economic aid or trade in this respect;

Figure 1. Exports of major weapons to the Third World compared with world trade, 1962–80



Sources: Exports of major weapons to the Third World—SIPRI data bank. World trade—United Nations *Statistical Yearbook, 1974* and *1978*; *UN Monthly Bulletin of Statistics*, January 1982.

it is virtually the only area in which they have successfully rivalled the West.

In the United States, the policy of restraint on arms sales, which President Carter enunciated in a May 1977 directive, has now been abandoned. A new directive was issued in July 1981, which reinstates arms sales as a major instrument of foreign policy. Security assistance authorized for the fiscal year 1982 shows an increase of 30 per cent, compared with fiscal year 1981; a substantial part of that assistance consists of foreign military sales financing. Human rights issues, as embodied in Carter's 1977 directive, will not be a significant consideration. The constraint of not introducing advanced weaponry that would raise the combat capability in any given region—also in the 1977 directive—has been abandoned as well. Thus, South Korea will get an initial batch of

36 F-16s, which is an introduction into that region of weaponry of a significantly higher technological level than before.

The main events in the US arms trade in 1981 were the deals with Pakistan and Saudi Arabia; and there was the significant decision that China could, if it wished, buy 'lethal' weapons from the United States—though there are few signs of China wishing to do so at the moment. The United States negotiated a $3.2 billion five-year military and economic package with Pakistan, including 40 F-16 fighters. With Saudi Arabia, an air defence package was negotiated which is probably the largest single arms transaction of the post-war period. It includes five AWACS aircraft, six aerial refuelling tankers, 1 177 Sidewinder air-to-air missiles, and 22 ground-based radar installations. Given the historical Saudi opposition to foreign military bases on their soil, the AWACS deal is the nearest thing to a prepositioned base that the United States is likely to obtain at this stage, at least until the Saudis themselves are able to operate and maintain these systems.

West European countries have been pushing arms sales in 1981. The new French Administration does not appear to have made any change in French arms export policy: for instance, during 1981 France delivered Mirage fighters to Iraq and missile-armed attack boats to Iran. Libya also received French weapons during much of 1981. The UK has been promoting sales of the British Aerospace Hawk, Chieftain tanks and Rapier surface-to-air missiles in the Middle East; it has also lifted the embargo on arms sales to Chile. FR Germany is under some pressure to change its policy prohibiting sales to 'areas of tension'; because of this policy, a large sale of tanks and armoured vehicles to Saudi Arabia is still pending. In recent years, Italy has emerged as the world's fourth largest exporter of major weapon systems, with a policy which enables firms to export to virtually any country in the world.

Some Third World countries are now increasing their share of the arms trade with exports of domestically produced weapons. Because of the lower unit prices it is mainly other Third World countries that buy these weapons. Brazil has a booming arms industry—for example, the Engesa Company reportedly sells approximately 1 000 armoured vehicles a year to 32 countries.

The Israeli arms industry is one of the largest employers in Israel. In 1981, for instance, it sold substantial quantities of tank ammunition to a number of countries, including Switzerland; the Galil rifle was another prominent export item. There were also Israeli arms transfers during 1981 to Iran, including spare parts for US-built M-48 tanks and for F-4 Phantom fighters.

II. Weapons

Strategic nuclear weapons

The confrontation between the two great powers in intercontinental nuclear weapons is becoming increasingly uneasy. Each side claims that the other side is trying for some kind of first-strike capability, while declaring its own objective to be solely defensive. The United States' scenario is that the Soviet Union launches a strike which eliminates all US land-based missiles. It still has enough strategic nuclear weapons in reserve to inhibit the United States from making any reply with its submarine-launched missiles.

It is difficult to believe that any sane ruler would order a first strike of this kind—except as a pre-emptive move, in the belief that the other side was about to do the same. The risk of total catastrophe to his own country would be very large. As a realistic technological and political option, a first strike limited simply to land-based missiles lies in the realm of myth.

However, it is this myth which is being used as a rationale for the very big increases which are in prospect in strategic weapon programmes and procurement. It is also the rationale for the renewed advocacy in some strategic journals and elsewhere of a launch-on-warning system to prevent land-based missiles being caught in their silos. These missiles should be launched, without reference to the head of state, as soon as various detection devices suggest that the missiles from the other side have left their silos.

The Soviet Union is proceeding with the modernization of its land-based missiles, replacing old missiles with SS-17s, SS-18s and SS-19s. The great majority of these newer missiles are equipped with MIRVs (multiple independently targeted re-entry vehicles). The replacement of old missiles by these newer types will probably be complete by the mid-1980s. It is also anticipated that the Soviet Union will develop solid-propellant intercontinental ballistic missiles to supplement or replace some of the current liquid-propellant ones.

The most modern class of Soviet missile submarine which is operational is the Delta class, with missiles which have a range of 8 000–9 000 km. These missiles can be fired at most targets in the United States from waters close to the Soviet shore, such as the Barents Sea and the Sea of Okhotsk; thus the submarines can reduce their exposure to US anti-submarine warfare systems. In 1980, the Soviet Union launched a new, much larger strategic nuclear submarine, the *Typhoon*. This, it is believed, will carry some 20 ballistic missiles, each missile with probably 12 warheads; it will also be able to cover most targets in the United States from

Soviet home waters. It could also be deployed under the ice of the Arctic Ocean, as further protection against US anti-submarine tactics.

The Soviet Union has not taken any action for over a decade to deploy any new long-range bombers. It maintains a formidable air defence system, which it will probably wish to upgrade to deal with the US cruise missile threat.

The United States proposes to press ahead with the production of the new MX land-based intercontinental missile, which will have three times the throw-weight of the Minuteman III missile and can carry 10 warheads of about 500 kilotons each. The proposal is to deploy some 35–40 of these missiles in existing ICBM silos, and in the meantime to look at long-term basing options for this missile. One of these options—developing ballistic missile defence for the missile sites—would require the revision, or indeed possibly the abandonment, of the Anti-Ballistic Missile Treaty.

The bomber programme is the largest element in the strategic programme. Firstly, it is proposed to upgrade the B-52G and B-52H bombers so that they can carry some 3 000 cruise missiles. Secondly, 100 B-1 bombers will be built, also equipped to carry air-launched cruise missiles. Thirdly, there is an intensive research and development programme for the Advanced Technology ('Stealth') bomber. In addition to the deployment (which has begun) of the air-launched cruise missiles for the bombers, it is proposed to deploy Tomahawk cruise missiles, some of which will be nuclear-armed, on submarines and surface ships.

The first of the new Ohio-type ballistic missile submarines was commissioned in November last year; it will carry 24 Trident missiles, each with 8 100-kiloton MIRVed warheads. Eight such submarines are now being built. The development has begun of a more advanced Trident missile, the Trident II, with a longer range, and carrying more warheads. The Trident II is expected to be as accurate as a land-based ICBM. The strategic weapon programme in the USA also includes substantial expenditure on improved communications and control systems.

Nuclear explosions

Of the 49 nuclear explosions which took place in 1981, the USSR carried out 21. (Five of these were conducted outside the Soviet weapon testing sites and are therefore presumed to have served non-weapon purposes.) The USA conducted 16 nuclear weapon test explosions at the usual site in Nevada; the UK conducted 1, also in Nevada; and France conducted 11 on the atoll of Mururoa in the Pacific Ocean. China did not test at all last year.

All explosions in 1981 were carried out underground and, according to data obtained from the Hagfors Observatory in Sweden, all had a yield below or around 150 kt (the yields of the French tests were 20 kt or below).

The rate of testing in the past four years—around 50 a year—has been significantly higher than in the previous four years (1974–77 inclusive), when the average was 37 tests only. There has been no downward trend since the 1963 Partial Test Ban Treaty.

The military use of space

At least three-quarters of all satellites are used for military purposes. They are intricately connected with the development of the new strategies for nuclear weapons which have evolved with the increasing accuracy of those weapons. Satellites are used to obtain precise knowledge of the targets and their locations, and are also used in the command, control and communications systems which transmit targeting information and which direct the actions of the offensive forces.

Satellites are obviously vulnerable, and the military are concerned to find ways of improving the survivability of their own satellites, and of attacking the satellites of the potential enemy. The United States, for instance, is devoting resources to hardening the electronic components of space systems, so that they are less likely to be damaged by an electromagnetic pulse (EMP) which can be produced by the explosion of a nuclear warhead. The US Air Force has also proposed a satellite which would orbit at an altitude of around 200 000 km and would have manoeuvring capabilities. Both sides have been experimenting with methods of destroying the other side's spacecraft. The Soviet Union launched a target satellite and two interceptors during 1981. The United States is planning to begin operational testing of its anti-satellite (ASAT) system in 1983. This consists of a miniature homing vehicle which would be guided to its target by an infra-red homing device, and which could be launched from aircraft flying at an altitude of some 20 km.

Both the USA and the USSR are investigating high-energy laser and particle beams for ASAT applications. By the end of fiscal year 1981, the Department of Defense will have spent about $1.5 billion on investigations into laser weapons; even so, the United States claims that the Soviet Union is ahead in this field. The chances are that both are roughly equally advanced. During 1981, the US Air Force conducted a number of tests of its laser weapon against a Sidewinder air-to-air missile.

The neutron bomb

A neutron bomb, or an enhanced radiation weapon, is a nuclear weapon so designed that the fraction of energy released as prompt radiation is much higher than in the standard nuclear weapon, and the fraction released as blast effects is much lower. In the late 1970s, the United States developed enhanced radiation warheads for the Lance missile with a range of about 100 km and for the 203-mm artillery howitzer with a range of 29 km. In 1978, President Carter approved production of the non-nuclear but not the nuclear components for these new warheads. In the summer of 1981 President Reagan authorized, without consulting his NATO allies, the procurement and stockpiling of the complete enhanced radiation warheads. He said they would not be deployed overseas at this time. However, they are clearly intended for Europe, and would have to be moved there if they were to have any function.

The arguments presented for the new weapons are that, if used against tanks or other targets, the blast effect would be less than that of standard nuclear weapons, and the damage to civilian life and property would be less. It would therefore be more credible to the Soviet Union that they might be used, and the Soviet Union would thus be deterred from attempting a tank attack. However, the neutron bomb is not a prescription for a safe nuclear war for Europeans. First of all, significant radiation casualties could be expected over an area of 10 square kilometres for each neutron weapon used: if 1 000 such weapons were used—and that is what might be needed—there could be anything up to some 10 000 square kilometres in which Europeans would be subjected to dangerous radiation exposure.

Secondly, if they were used, the likelihood is that the Soviet Union would retaliate with nuclear weapons of its own. Once these weapons are deployed, the main danger is that the reduced blast effect might make the decision to use these weapons easier to take. The decision to fire them would probably be delegated to local commands, and hence the nuclear threshold would be lowered. Crossing the threshold from conventional weapons to the first use of any nuclear weapon would create a high risk of escalation to a nuclear war in Europe.

France is also developing neutron bombs, but a decision about their production has not yet been taken.

Laser enrichment of plutonium

There seems likely to be a rising demand in the United States in the next decade for weapon-grade plutonium. In recent years, new supplies were not needed: plutonium was recycled from obsolete nuclear weapons into new ones. Now the situation has changed. Firstly, the US rearmament programme will mean a big increase in the number of nuclear warheads deployed—certainly several thousands more, and possibly as many as 10 000 more. Secondly, plutonium is preferred to uranium in most types of nuclear warhead. Thirdly, there is competition between tritium and plutonium for the limited capacity of existing production reactors: tritium is essential for the production of all fusion weapons.

In the United States there has been a substantial research and development programme into new techniques for the enrichment of uranium. The same techniques could be used to enrich reactor-grade plutonium—the plutonium produced by the civil nuclear power industry—so that it became weapon-grade material. One such technique, which may be near the pilot plant stage, is laser enrichment. If a way is found of converting reactor-grade plutonium into weapon-grade plutonium at no great cost, the link between civil nuclear power technology and military nuclear weapon technology will be further strengthened. Moreover, the offer made by some nuclear weapon states to submit their civilian nuclear activities to international safeguards would become meaningless. Such a development would weaken the legitimacy of the Non-Proliferation Treaty and its attendant system of safeguards.

Chemical and biological warfare (CBW)

In February 1982, the President of the United States certified to Congress that it was essential to the national interest that production of chemical weapons should be resumed in the United States, after an interval of over a decade: there has been no significant production of filled poison-gas ammunitions in the United States since 1969. The world is moving to the verge of a chemical arms race that could make impossible any further strengthening of the arms control measures in this field.

The present CBW arms control arrangements rest on the 1972 Biological and Toxin Weapons Convention (BW Convention) which outlaws the development, production, stockpiling and international transfer of these weapons, and on the Geneva Protocol of 1925. The latter agreement has an important weakness: there is no international verification machinery to deal with allegations of the use of these weapons. The attempts over the past 10 years to strengthen the control over chemical weapons have so far been unsuccessful.

At the end of World War II, more than a dozen states possessed stocks of the latest chemical weapons. Now, there are only three states—France, the USA and the USSR—publicly known to possess militarily significant stocks. The current US stockpile is about 42 000 short tons of poison gas, of which about half is mustard gas, and the other half nerve gas. However, some of the nerve gas is stored in filled munitions which have either deteriorated over the years, or are obsolete. The supply of serviceable and ready-to-use poison gas munitions probably amounts to some 70 000 tons. (The tonnage of munitions exceeds the tonnage of the basic agents by a factor of about 10.) If the bulk-stored mustard and nerve gases were filled into munitions, that might add a further 200 000 tons. Most of this stockpile is held in the United States; the only two overseas stockpiles known are at Johnston Island in the Pacific and one ammunition depot in FR Germany.

US officials, not French ones, have confirmed the existence of a French chemical-weapon stockpile; it is reckoned to amount to some hundreds of tons of nerve gas.

The West has no firm information about the size of the Soviet stockpile. Soviet officials have made no direct public reference to the existence of such weapons in the Soviet Union since 1938. Current professional estimates range from less than 30 000 to more than 700 000 tons of chemical agents. This has given rise to the frequent quotation of the arithmetic mean of these two figures—350 000 agent-tons. This would correspond to about 3 300 000 tons of filled munitions—a figure so enormous as to cause grave doubts about its plausibility. The chemical agents said to be stockpiled include a variety of types of World War I and II vintage, as well as nerve gases. There is no hard evidence that the Soviet Union has been producing chemical agents or munitions during the 12 years that have elapsed since US production stopped. The Western officials who refer to a build-up have been referring, not to continued production of chemical weapons, but to the continuing build-up of anti-chemical protection that had commenced during the 1960s, coupled with the increased deployment of weapon systems capable of firing, among other things, chemical ammunition.

There are a number of sources of pressure which may sweep away the constraints which have held back a chemical arms race during the past decade. New technology makes it simpler to assimilate chemical weapons into military inventories. Chemical agents are now quick-acting, and in this respect more closely resemble conventional weapons. They are packaged in ammunition which can be used with conventional weapon systems, so that there is no longer any call for special chemical troops. The latest innovation is 'binary' nerve-gas munitions. These are shells, bombs or rocket-warheads filled, not with actual nerve gas, but with separate loadings of much less toxic chemicals adapted to mix and react together to generate nerve gas only when the munition is on its final target course. Binaries do away with the need for expensive and dangerous super-toxic chemical factories, and have sufficiently enhanced storage and handling safety to allow combat units to carry supplies with them.

It is true that adherence to the Geneva Protocol requires the military to speak only in terms of deterrence: the possession of poison gas, it is argued, is simply to deter the other side from using it. However, once these weapons have been integrated into the force structure—which indeed is necessary for them to fulfil their reputed deterrent function—the military will undoubtedly begin to look beyond deterrence to scenarios in which the no-first-use policy is abandoned.

Allegations of the actual use of chemical weapons, and other infractions, have added to the pressure against the existing arms control constraints. The allegations of the use of chemical agents in Laos, Kampuchea and Afghanistan are being examined by an expert investigatory group convened by the Secretary-General of the UN; its interim report, released in mid-November 1981, "found itself unable to reach a final conclusion as to whether or not chemical warfare agents had been used. ... Any investigation designed to lead to definite conclusions ... would require timely access to the areas of alleged use. Such an exercise has so far not been possible." The United States has also reiterated its accusation that the Soviet Union has acted in violation of the 1972 BW Convention. The event which stimulated the US action was an outbreak of human anthrax in 1979 in the region of Sverdlovsk—long known to be an area where anthrax is endemic. For reasons not made public, US evaluators suspect that the victims were suffering from the pulmonary rather than the intestinal form of the disease, and are unwilling to accept the Soviet explanation that it was caused by infected meat. These suspicions have been allowed to grow by the absence of any verification provisions in the Convention. There are also Cuban allegations attributing, for example, outbreaks of sugar-cane rust and blue mould of tobacco to CIA activities.

Finally, the fact that chemical disarmament negotiations were making some progress served to alert the protagonists of chemical weapons. The constant references to the existence of a chemical-warfare gap *vis-à-vis* the Soviet Union began in the summer of 1977, soon after the negotiations were joined in earnest. The arguments were presented for negotiating from a position of strength, requiring some 'bargaining-chip' chemical rearmament. On the Soviet side, there was a refusal to accept mandatory on-site inspection even of the destruction of stockpiles.

The US Department of Defense is now building a full-scale factory for making new binary nerve-gas munitions. It should be ready for operation during the fiscal year 1983, and will have a capability of 20 000 155-mm rounds per month. Next off the production line would be the 500-pound binary-VX aircraft spray-bombs (Big Eye). After that, binary warheads are being considered for a range of rockets and missiles, including the ground-launched cruise missile.

III. Arms control and disarmament

If this section were restricted to summarizing actual progress made during 1981 in arms control and disarmament, it would be short. No progress was made. There is a long list of negotiations and discussions which lie dormant (or possibly dead). Negotiations on a comprehensive test ban were adjourned in November 1980. They have not been resumed, and the US Administration has indicated that it has no interest at present in their resumption. There were talks between the United States and the Soviet Union in 1978–79 on possible control of anti-satellite systems; around the same time there was also some discussion between them on possible restraint in their sales (or gifts) of conventional arms. Neither of these discussions has been resumed. Negotiations between the United States and the Soviet Union on chemical weapons have also been in abeyance—although multilateral discussion has continued in the Committee on Disarmament.

No progress has been made at the Vienna talks—now in their ninth year—on mutual (balanced) force reductions in Europe; and at present there does not seem much chance that an agreement on the holding of a European Disarmament Conference will emerge from the Conference on Security and Co-operation in Europe in Madrid.

Perhaps the most dangerous hiatus is the absence of any negotiations on strategic nuclear weapons. The second treaty on strategic arms limitations (SALT II), laboriously negotiated over seven years, was not put to the US Senate for ratification by the previous Administration; and the present US Administration considers that the treaty is fatally flawed. However, after a year in office the new US Administration has still not agreed to a date for resuming talks. It has simply indicated that it wishes to talk about reductions rather than limitations: it has also hinted that it may have strong requirements for verification.

The one set of negotiations which has got under way is on long-range theatre nuclear forces in Europe—the LRTNF negotiations. They began in November 1981—although it is difficult to see how far they can get, unless complemented by negotiations about strategic nuclear weaponry. The following summaries begin with the LRTNF issues: a fuller summary is given at the beginning of the chapter itself, on page 3. Summaries of the Nordic proposals for a nuclear weapon-free zone (NWFZ), and of the state of negotiations at Madrid then follow. There are finally notes on militarization and arms control in Latin America, on the stage which negotiations on a comprehensive test ban had reached before they were adjourned, on the Soviet proposal for banning weapons in outer space, and the proposal for an international satellite monitoring agency.

Long-range theatre nuclear forces in Europe

Since the 1950s, the Soviet Union has had a large number of missiles with nuclear warheads targeted on Western Europe—to that extent the SS-20s do not represent an entirely new threat. The decision to replace the SS-4s and SS-5s with SS-20s may have been taken without much attention to the international political consequences. In fact, West European nations have been much concerned at the increased capabilities of these new missiles, while at the same time they were beginning to doubt whether their forward-based aircraft could continue to penetrate Soviet air defences.

In recent months, the two sides now negotiating on this matter have put forward widely different assessments of the balance. A reasoned judgement is that, whether the comparison is limited to missiles, or whether it includes aircraft as well (where the problem of deciding what to include is much more difficult), the Soviet Union appears to have a superiority in long-range theatre nuclear forces in Europe of about 2:1. Insofar as there is concern to change this particular regional balance, then obviously it is better to do so by reductions on the Soviet side than by increases on the NATO side.

If indeed new missiles were installed on the NATO side, it is a mistake to think that they would serve to re-establish the United States' 'nuclear umbrella'. There is no doubt that, if a war broke out in Europe, both major powers would attempt to keep their own homelands free from attack with nuclear weapons by initially avoiding attacks on the homeland of the other side. Thus, the new missiles, if introduced, would in all probability have a set of targets in Eastern Europe, west of the Soviet border. For if a nuclear missile fired by US forces strikes the Soviet Union, the Soviet Union would in all probability retaliate against the United States, whether the missile came from the Federal Republic of Germany or from Montana.

The Geneva negotiations, if they are to have significant success, must soon be linked with strategic arms limitation or reduction talks. Otherwise it would be too easy to negate the effect of any agreement reached—for instance by the deployment of cruise missiles on ships in northern European waters, or by introducing new missiles with ranges below 1 000 km.

By the end of 1981, the Soviet Union had some 175 SS-20 missile launchers within striking range of Europe. The number of warheads carried by 175 SS-20s is roughly the same as the number deployed on SS-4s and SS-5s before the SS-20 was introduced. The number of launchers, 175, is also roughly the same as the number now deployed by the UK and France combined. So the *status quo ante*, and a rough matching of Soviet missile systems with those of the UK and France, could be obtained by freezing the number of SS-20 launchers at their end-1981 number and eliminating all the SS-4s and SS-5s.

Nuclear weapon-free zone: Nordic initiatives

The Nordic area is not itself likely to become a source of major power conflict. However, there is an increasing risk that it may become an arena of international rivalry, with the spread of more effective nuclear war-fighting weapons to northern Europe. The proposal for a nuclear weapon-free zone (NWFZ) in the area is aimed at making it a kind of low-tension buffer zone between the major powers.

There are three main characteristics of a NWFZ: non-possession, non-deployment and non-use of nuclear weapons. All the Nordic countries have ratified the Non-Proliferation Treaty. None of them possesses or deploys nuclear weapons in peace-time, or allows them to be deployed by other countries. The main change that a NWFZ in the Nordic region would require would be that Norway and Denmark would agree not to allow the deployment of nuclear weapons on their territories in times of war. In the established definitions of a NWFZ, the prohibition applies to nuclear explosives only. There may indeed be other installations on the territories of the Nordic countries, such as sonar arrays and navigation aids for submarines, which are linked to the global nuclear-weapon strategies of the great powers; however, attempts to extend the scope of the prohibition would lead to reduced clarity.

Transit provisions would have to be regulated by the treaty, otherwise transits could be so frequent that the basic provisions could be undermined. Overflights of aircraft or cruise missiles carrying nuclear weapons would have to be prohibited: the treaty would have to negotiate provisions that cruise missiles would not be located in such a way that their trajectory would almost certainly cross zone territory.

The Soviet Union has indicated its willingness to consider "measures applying to [Soviet] territory in the region adjoining a nuclear free zone in the north of Europe". The candidates for elimination include a number of missiles in the Leningrad military district which are in all probability intended for strikes against Nordic targets; there might also be a total ban on submarine-based nuclear weapons in the Baltic Sea. Limitations near Denmark would depend probably on some progress being made in confidence-building measures over a wider European area.

A Nordic nuclear weapon-free zone could be considered as a first step towards more comprehensive measures covering the whole of Europe: alternatively, if any broader European arrangements were to be agreed first, it might be established within that framework. It could be considered together with other suggestions for confidence-building measures, such as some restrictions on anti-submarine warfare activities, or a demilitarized area along the Norwegian–Soviet border.

The case for some disengagement in northern Europe is strong, since the alternative is not the *status quo* but a big increase of military capabilities in the area. However, there is the major problem of finding a design which is acceptable to the major powers.

European Disarmament Conference

The possibility and problems of convening a European Disarmament Conference (EDC) have been discussed now for over a year at Madrid at the second review conference of the Helsinki Final Act. This conference is known as the Conference on Security and Co-operation in Europe (CSCE). The talks have gone on for so long because, although the international atmosphere has not been propitious to an agreement, no party is anxious to take the responsibility for ending the discussions. Most states at the CSCE seem to believe in the need for convening an EDC. The differences between them concern the preparations and agenda for such a conference.

The background to the security issues dividing the CSCE may be set out by summarizing the Polish and French proposals. The Polish proposal was for a step-by-step advance from the confidence-building measures (CBMs) adopted at Helsinki towards arms control and disarmament measures, and for a conference at which a wide range of proposals could be put forward and considered. The French proposal was for a more ambitious and more detailed exchange of military information: a set of CBMs for which four criteria should be agreed before an EDC was convened. The new CBMs should be significant in military terms; they should be binding, not voluntary as heretofore; there should be appropriate verification; and they should be applicable throughout Europe from the Atlantic to the Urals. When these CBMs had been adopted and implemented, arms control and disarmament negotiations could be started.

The main controversial issue has been the area of application. The Helsinki CBMs apply to the whole of Europe, except for the Soviet Union where only the area within 250 km of the frontiers with other European states is covered by the requirement to notify manoeuvres. The Soviet Union has indicated that it might accept the extension of the area to the entire European part of the USSR, provided the western states also extended corresponding zones accordingly. The problem has been to agree how to compensate for the Soviet concession 'accordingly'. There is the possibility of establishing zones in the waters surrounding Europe where military activities would be notified; alternatively, certain military activities outside Europe which were connected with activities inside Europe could come under the notification requirement. Possibly the concessions could combine both geographical and functional requirements.

Militarization and arms control in Latin America

The application of an arms control regime to a whole inhabited continent is a new development. Latin America is unique as the first nuclear weapon-free zone on a continental scale and in a populated region, established by the 1967 Treaty of Tlatelolco. However, this has not prevented further militarization of the region in recent years.

In particular, the strength of the armed forces has almost tripled in the past two decades in Central America and the Caribbean. The militarization of this sub-region has been accompanied by an intensification of internal violence in many of these countries. In El Salvador, for example, as many as 35 000 people were killed from 1979 to the end of 1981.

South American countries have also been involved in a formidable expansion of their military potential, mainly because of the revival of inter-state border conflicts, as well as internal upheavals. Brazil and Argentina have developed significant arms industries, and are widely believed to be seeking nuclear weapon capabilities. Neither of them is a party to the Treaty of Tlatelolco.

Under these circumstances, it has not proved possible in Latin America to move on from the Treaty of Tlatelolco to further arms control measures.

Comprehensive test ban

Before the negotiations were adjourned in November 1980, a number of important points had been agreed. In particular, important advances had been made in the matter of verification. The treaty would provide for consultations to resolve questions that might arise concerning compliance, and any party would have the right to request on-site inspection for the purpose of ascertaining whether or not an event on the territory of another party was a nuclear explosion. The three negotiating parties had also agreed in principle on a number of high-quality, tamper-proof national seismic stations of agreed characteristics, to be installed on the territories of the three parties.

Although the principle of on-site inspection had been agreed, the various procedures of the inspection process had not. Another issue which may need settlement is the question of laboratory tests which could consist of extremely low-yield nuclear experiments.

There was also a point at issue on the duration of the treaty. The initial duration was to be only three years; the United States did not want to to make, in the treaty, a provision for possible extension, while the Soviet Union preferred to stipulate that the ban would continue unless the other nuclear weapon powers, not parties to the treaty, continued testing.

A comprehensive test ban ought at least to make it difficult for the nuclear weapon parties to be certain about the performance of new weapons that are developed, and to that extent would narrow one channel of arms competition among the major powers. It would also reinforce the Non-Proliferation Treaty by demonstrating that the major powers had some awareness of their legal obligation to bring the nuclear arms race to a halt.

Two proposals concerning outer space

In 1981 the Soviet Union proposed a treaty of unlimited duration, which would prohibit the stationing of weapons of any kind in outer space, including stationing on "reusable" manned space vehicles (a clear reference to the US space shuttle programme). Moreover, the parties to the treaty would undertake not to destroy, damage or disturb the normal functioning or change the flight trajectory of space objects of other states, if such objects were placed in orbit in "strict accordance" with those provisions. Compliance with the treaty would be assured by the national technical means of verification at the disposal of the parties and, when necessary, the parties would consult each other, make inquiries and provide relevant information.

This proposal is not, as yet, fully elaborated. For instance, it is not clear who would make the judgement as to whether or not objects were placed in orbit in accordance with the provisions of the treaty. Although the proposal is for a multilateral treaty, only the two major powers would have available to them "national means of verification". Further, it is probably desirable that the treaty should cover, if possible, weapons that could strike space objects from the ground or from the atmosphere.

A report has also been prepared for the United Nations General Assembly on the possibilities for setting up an international satellite monitoring agency (ISMA). The report concludes that space technology will allow observations from satellites for the verification of compliance with arms control and disarmament treaties and for monitoring crisis areas. The annual cost of an ISMA to the international community would be very much less than 1 per cent of the total yearly expenditure on armaments. There are, of course, difficult questions about the distribution of the data and the information which such an agency might acquire. There are political, organizational and financial difficulties. The idea of an ISMA could be the beginning of a multinational verification agency. However, both the USA and USSR have so far been negative, and have refused to participate in the group.

Part I. European security

Chapter 1. Long-range theatre nuclear forces in Europe

The issues / The history of LRTNFs / Force comparisons / Theatre nuclear doctrines / The role of cruise and Pershing missiles in US strategy / Divergent interests across the Atlantic: European concerns / Approaches to arms limitation

Chapter 2. The CSCE and a European disarmament conference

Background / The EDC proposals / Notifications of military manoeuvres in 1981, in compliance with the Final Act of the CSCE

Chapter 3. The neutron bomb

What is a neutron bomb? / What are the security justifications for the neutron bomb? / Current status of the neutron bomb programme / The effects of nuclear weapons / Effectiveness of nuclear weapons against tanks / Collateral effects / Likelihood of nuclear war / Conclusions

Chapter 4. Nordic initiatives for a nuclear weapon-free zone in Europe

Introduction / Objectives / Characteristics / The meaning of 'nuclear weapon-free' / Geographical domain / Transit provisions / Deployment limitations in areas adjacent to the zone / Verification / The European connection / Collateral measures / Prospects and procedures / Concluding remarks

1. Long-range theatre nuclear forces in Europe

Square-bracketed numbers, thus [1], *refer to the list of references on page* 48.

I. The issues

The current debate on nuclear weapons in Europe may significantly affect the political orientation of European countries and the shape of their defences. It has already had a substantial impact on European threat perceptions: while the two major powers perceive each other as posing the gravest threat to their security, many Europeans see the US–Soviet conflict as representing the gravest threat to European security.

At the centre of attention are the long-range theatre nuclear forces (LRTNFs). The essential aspects of the LRTNF issue may be summarized as follows.

1. New Soviet weapons, in particular the SS-20 missile, have provoked considerable concern in Western Europe. In times of peace, they are a source of anxiety; in times of crisis, they could be used for purposes of intimidation and blackmail; in times of war, Soviet doctrine emphasizes initiative, surprise, deep strikes and massive use, which can now be executed with greater precision than before. The Soviet Union has a numerical lead of more than 2:1 in LRTN systems—in aircraft as well as missiles—within striking range of Europe.

2. The military rationale for the NATO decision to deploy cruise and Pershing missiles was to keep open the option of striking a substantial number of targets in the USSR from Western Europe (thereby enhancing the 'nuclear umbrella' over Western Europe). Existing forces were no longer considered adequate for that purpose. Politically, however, the need for new weapons was ascribed to the Soviet LRTNF build-up—initially by West European politicians in particular. To justify the modernization request, the SS-20 was singled out for particular attention. However, Western Europe had been living under the shadow of Soviet LRTN missiles for almost 20 years.

3. For the Soviet Union, the replacement of old SS-4 and SS-5 missiles was technologically overdue, and the decision to deploy the SS-20 may have been taken without much consideration for its impact on international affairs. The concerns of leaders in the East and the West were therefore badly synchronized: while many Western politicians 'rediscovered' the Soviet missile threat when the SS-20 was introduced, Soviet leaders did nothing to allay the fears. For more than two years after the first missiles were deployed and for many months after NATO's

deployment plan was substantiated, the Soviet Union made no major political move on LRTNFs.

4. The US nuclear umbrella—the notion that in defence of Western Europe the United States is willing to use nuclear weapons not only on the battlefield, but also against the Soviet Union—has folded up. Should a war break out between the military alliances in Europe, both the USA and the USSR would do their utmost to keep their own territories out of the conflict. The deployment of cruise and Pershing missiles in Western Europe does not change this. If Soviet territory were struck by US nuclear weapons, it must be assumed that the Soviet Union would retaliate against US territory, regardless of the launching point or physical characteristics of the delivery vehicle. The targeting policy for cruise and Pershing missiles is therefore likely to comprise alternative sets of targets, tailored according to different war scenarios. In the case of a European battle, the missiles may be used against East European countries; in a strategic exchange, against the Soviet Union.

5. For the United States, the main military interest in deploying new missiles seems to be of a strategic nature. The Pershing II will be one of the most capable counterforce weapons in the US arsenal, should it ever be deployed in Europe. It has superior characteristics for limited strikes, is ideal for use against time-urgent targets (such as missiles, command and control centres, quick-reaction alert aircraft and submarines in port), and therefore fits the requirements of the countervailing strategy, codified in Presidential Directive 59.

6. For the European countries, new missiles make a difficult situation even worse. More effective war-fighting weapons, introduced in a major power competition which is not of European making but in which Europeans—East and West—may become the main losers, are clearly detrimental to their security. The host countries would, moreover, be burdened with a number of high-priority nuclear weapon targets, which would make it virtually certain that Western Europe would be drawn into any strategic war between the two great powers.

7. To avoid circumvention and ensure substantial limitations, the LRTNF negotiations that started in Geneva on 30 November 1981 should soon overlap with resumed US–Soviet talks on strategic arms, and also lead on to limitations of systems of shorter range. All targets that can be struck by the new Soviet and US theatre systems can, for instance, be hit by intercontinental systems as well. A mere reduction of LRTNFs will therefore lose much of its military significance if intercontinental systems are allowed to increase unchecked.

8. US LRTNFs in Western Europe can reach the Soviet Union, while the MIRVed SS-20 cannot reach the United States. Between the two major powers, parity in intercontinental systems and parity in LRTNFs

are therefore incompatible with overall strategic parity. Given that the SALT agreements have established a kind of parity in intercontinental systems, the only regional level which is compatible with overall strategic parity is that which is defined by the figure zero. A solution making the deployment of cruise and Pershing missiles in Western Europe superfluous would, therefore, not only enhance the security of European states, but also facilitate progress in US–Soviet strategic arms limitation.

9. Cruise missiles, the sea-launched version (SLCM) in particular, may become formidable obstacles to effective arms limitation. In an international atmosphere of deep distrust, they raise unprecedented demands for ingenuity in the field of verification; should current plans for wide dispersal of SLCMs be implemented, effective verification would become extremely difficult. Substantial limitations on this technology may therefore be of fundamental significance for the future of arms control. Zero-level agreements, prohibiting certain categories of weapon altogether, are by far the easiest to verify. Should the deployment of SLCMs in waters adjacent to Europe proceed and not be regulated within the framework of resumed talks on strategic arms, it would radically alter the data base for the Geneva LRTNF negotiations.

10. By the end of 1981, the Soviet Union had some 175 SS-20 missile launchers within striking range of Europe. On the assumption that each missile carries three MIRVs (multiple independently targetable re-entry vehicles), the total number of warheads equals that which was deployed on SS-4s and SS-5s before the SS-20 became operational. In terms of launchers, the present SS-20 arsenal is roughly equal to those of the UK and France combined (175 versus 162 launchers). In quantitative respects, the *status quo ante* and a matching of Soviet missile systems with those of the UK and France can therefore be obtained by eliminating all SS-4s and SS-5s and freezing the number of SS-20 launchers. Such a move, establishing a balance in the number of LRTN launchers in the region but without affecting the strategic balance between the two major powers, would facilitate further endeavours towards nuclear disarmament.

II. The history of LRTNFs

Definitions

Theatre nuclear weapons can be divided into three categories, according to range.

Long-range theatre nuclear forces (LRTNFs) are nuclear weapons with a maximum range of more than 1 000 km, but less than 5 500 km (intercontinental range). For many weapon systems, the range specification is somewhat arbitrary, but serves the purpose of focusing attention on a certain set of nuclear weapon systems. Nor is it easy to classify all systems according to this criterion: for instance, the Soviet SS-22 missile, the successor to the SS-12 Scaleboard, is accredited with a range of about 1 000 km—perhaps a little more or less—and a number of aircraft are also extremely difficult to classify. In Soviet terminology, LRTNFs are described as operational-strategic weapons and are allocated to the Strategic Rocket Forces.

Medium-range theatre nuclear forces (MRTNFs) have a range of 200 to 1 000 km. These weapons are designed to support operations at the corps-army level or, in the Soviet case, at the army-front level.

Short-range theatre nuclear forces (SRTNFs) have a range up to 200 km. Often designated 'battlefield' nuclear weapons, these are primarily intended for use at the division and corps levels.

The term 'LRTNFs' is often used interchangeably with 'eurostrategic weapons'; the term 'eurostrategic' refers to strategic uses against targets in Europe. 'Strategic' use refers to strikes against the socio-economic structure of the opponent, or his offensive and defensive strategic armoury and associated infrastructure. 'Tactical' use refers to attacks on targets with more or less direct effects on the course of battle. This dichotomy leaves a grey area of targets whose importance for the tactical situation is more remote, such as ports, roads, railway-yards, and command, control, communications and intelligence (C^3I) centres: LRTNFs can also be used for interdiction strikes against such targets (see section V). In the nuclear arms limitation talks that started in Geneva in November 1981, world-wide as well as regional, European limitations have been proposed; also for that reason, LRTNF is the more appropriate term to use.

The US forward based systems

In the summer of 1949, the United States deployed 32 B-29 bombers in the UK. The B-29 'superfortress' had a radius of operation of about 2 500 km, and therefore depended on forward bases for strikes against the Soviet Union. This was the beginning of the US forward based systems (FBSs) in Europe.[1]

At this time, the B-52 was on the drawing boards. However, in order to acquire jet-bomber capability as soon as possible, priority was given to the Boeing B-47 medium-range bombers; the technological challenge was less than for an intercontinental aircraft, and the overseas bases

[1] In November 1946, six B-29s 'toured' Europe and surveyed airfields for possible use. This is regarded as the first instance in which SAC bombers were used as an instrument of international diplomacy [1].

were regarded as safe. The B-47 entered operational service in 1951, and remained the mainstay of the US Strategic Air Command (SAC) for 10 years. More than 2 000 were built, and the last ones were phased out in 1966. B-47s operated from bases in French Morocco, Spain and the UK, with units rotating from the continental United States (CONUS).

Throughout the 1950s, a variety of other nuclear-capable aircraft—both land- and carrier-based—were also deployed in Europe and in European waters, some of them capable of striking against the Soviet Union.

The Karman Committee of 1945, which summarized the recent advances in science and technology, concluded that the USA should concentrate on developing jet aircraft, whereas missiles were relegated to the more distant future [2]. Nevertheless, the military services began small-scale missile programmes, often based on technology inherited from German wartime efforts. In the field of long-range vehicles, efforts were concentrated on aerodynamic, 'cruise' missiles. The Navy operated its dual-capable 650-km range Regulus cruise missile on board submarines from 1954 to 1964. The Air Force missile programme was somewhat more ambitious, and more than 1 000 dual-capable, supersonic Matador cruise missiles, with a range of about 800 km, were produced. The Matador was placed with units in the Federal Republic of Germany in the mid-1950s. Some years later, it was replaced by another cruise missile, the Mace A/B, with a range of up to 2 500 km. The Mace was withdrawn in the second half of the 1960s because of its vulnerability to new generations of jet-propelled air-defence aircraft.[2]

At the NATO meeting in Washington, D.C. in December 1957, it was decided to deploy long-range ballistic missiles in Europe. Around 1960, US Thor and Jupiter missiles became operational in the UK, Italy and Turkey. They had a range of approximately 3 000 km, and a warhead yield of 1.5 megatons (Mt). The Thor missiles deployed in the UK (60) were deactivated by the end of 1963, while the Jupiters (30 in Italy and 15 in Turkey) were phased out by 1965 [4]. The modest numbers and short lifetime were due to slow count-down, high vulnerability and, more importantly, the introduction of submarine-launched ballistic missiles (SLBMs) and intercontinental ballistic missiles (ICBMs). Polaris submarines were already patrolling the Mediterranean and the Norwegian Seas when the land-based missiles were withdrawn.

The advent of Soviet LRTNFs

Soviet LRTNF deployment came largely in response to the US forward based systems. They also compensated for the US lead in intercontinental

[2] At peak deployment there were five Mace A squadrons and one Mace B squadron in hardened sites in Europe, with 20–50 missiles per squadron [3].

weapons. While waiting for their own intercontinental missiles, the Soviet Union held Western Europe hostage. Finally, Soviet LRTNFs must be seen in relation to the British, French and, in Asia, to the Chinese nuclear forces capable of hitting Soviet territory.

Soviet LRTNFs reached a peak in the mid-1960s, when altogether 733 missiles were operational. Approximately 100 were directed against the Middle East, South Asia and the Western Pacific, and the rest were available for strikes against Western Europe, together with 880 bomber aircraft. The missiles were of three types: the 1 200-km range SS-3s (only 40), the 1 800-km range SS-4s, and the 3 500-km range SS-5s. All of Western Europe was within range of Soviet megaton-yield warheads. The bombers were of two types: the Tu-16 Badger and the Tu-22 Blinder.

While the SS-3 missiles were withdrawn, the increasingly vulnerable SS-4s and SS-5s were retained. Already by the mid-1960s the Soviet Union tried to resolve the vulnerability problem by developing a new mobile land-based missile, the SS-14 Scapegoat (designated Scamp when vehicle-mounted). However, it seems to have been a technological failure (although a small number of them were deployed in the Far East). Subsequently, intercontinental SS-11 missiles, and later also SS-19s, were deployed in the European theatre. At the same time, these deployments appeared to compensate for the transfer of part of the SS-4/SS-5 force to the Chinese border in 1968. At least 120 SS-11s and 60 SS-19s were deployed at SS-4/SS-5 sites at Derazhnya and Pervomaysk.[3] The mobile, intercontinental SS-16 missile, which was prohibited by SALT, finally gave rise to the SS-20, deployed from 1976/77 on: the SS-20 basically consists of the first two stages of the SS-16.

For intelligence services and military experts, the introduction of the SS-20 was therefore no surprise; on the contrary, it was technologically overdue. Moreover, theatre nuclear missiles had already been targeted on military–economic centres (such as ports and industrial centres), military and political command and control facilities, and strategic nuclear force components (such as airfields, nuclear weapon depots and detection and warning systems). So, while the SS-20 meant a leap forward in counterforce capability, it represented no radical departure in doctrine. Both technologically and doctrinally, the phasing in of SS-20s was a 'natural', almost unquestionable move. The decision may have seemed an easy one to make, and to a large extent it may have been reduced to a matter of military-bureaucratic automaticity, without much consideration of its impact on international affairs. However, for many Western political

[3] Garthoff indicates that the number of ICBMs designated for the European theatre has been in the range of 180–360 [5].

circles, the new missiles were seen as a sign of Soviet threat and aggressiveness. At a time of increasing East–West tension, exaggerations of the threat—both unintentional and deliberate—were only to be expected.

For more than two years after the first SS-20s were deployed, the Soviet Union neither took a major initiative nor made a major political statement on LRTNFs. When Brezhnev finally spoke in Berlin on 6 October 1979, he offered too little too late: too little, because the offer to reduce the number of launchers did not preclude an increase in the number of warheads targeted on Western Europe; and too late, because in effect, NATO's decision of 12 December 1979 had already been taken. Had the Soviet Union, for instance—as a follow-up to Brezhnev's visit to Bonn in June 1978, where LRTNFs figured prominently on the agenda—promised that it would not deploy more warheads on SS-20s than it would eliminate by removing old SS-4 and SS-5 missiles, much fuss might have been avoided. Then the search for a zero solution, making deployment of new missiles for Western Europe superfluous, could have had a much better start.

At that stage, however, the Soviet leaders do not seem to have been sufficiently geared to the political aspects and consequences of their SS-20 deployments. The concerns of leaders in the East and the West were, in other words, badly synchronized: while being a 'matter of course' for Soviet leaders, many Western politicians 'rediscovered' the Soviet missile threat when the SS-20 was introduced. In the West, the SS-20 was presented as a grave, new threat—erroneously so—while in the East, leaders displayed no political activity to allay the fears—a major blunder.

III. Force comparisons

Any comparison of NATO and WTO forces should, ideally, be dynamic and qualitative, based on assessments of survivability, penetrability, reliability, targeting options and employment doctrines, accuracy, exchange scenarios and the endurance of C^3I. However, attempts at quantifying these factors are bound to be arbitrary, and the whole exercise of very uncertain validity. The overviews given in tables 1.1–1.7 are therefore confined to relatively simple, quantitative force comparisons only. Missiles and aircraft are treated separately, although they are of course closely linked functionally. Air-to-surface missiles (ASMs) are treated together with the aircraft.

Missiles

Ballistic missile systems that have been assigned to European missions but are accounted for in the SALT II Treaty, notably Soviet SS-11s, SS-19s and SS-N-5s on Hotel II-class submarines, and US Poseidon warheads allocated to SACEUR (the Commander of NATO forces in Europe) for targeting, are not included in the comparison. In the official US and Soviet LRTNF estimates presented shortly before the opening of the Geneva talks, neither party included them. At the low end of the range spectrum, the Soviet SS-12 Scaleboard and the Western Pershing IA, with ranges of 800 and 740 km, respectively, clearly fall into the MRTNF category. The Soviet SS-22 missile, intended to replace the SS-12, has a somewhat longer range, but probably does not exceed 1 000 km. US figures include 100 SS-12/SS-22s, while the Soviet Union claims that only 50 SS-12s exist and that the SS-22 is not yet operational.

Sea-based cruise missiles such as the Soviet SS-N-3 Shaddock and the SS-N-12 Sandbox may be employed in strategic land-attack roles. However, they have ranges below 1 000 km, are intended primarily for anti-ship use, and are therefore not counted.[4]

The WTO arsenal

The Soviet SS-4 Sandal and the SS-5 Skean are inaccurate, high-yield (1 Mt) weapons. They are liquid-fuelled and have very long reaction times. Some were deployed in silos, but most (some 80 per cent) were surface-mounted and reloadable. The SS-20, on the other hand, scores high on readiness, mobility, accuracy, firepower and range. It must, however, be fired from physically prepared positions. In addition to the MIRVed version (with three 150-kt warheads), there seems to be at least one single-RV (re-entry vehicle) version, achieving intercontinental range. While not the 'wonder weapon' some Western commentators claim it to be, the SS-20 undoubtedly represents an order-of-magnitude improvement in the Soviet capability to destroy time-urgent and semi-hard targets.

Towards the end of 1981, about 250 SS-20s were operational, in regiments of nine launchers and possibly with one reload missile per launcher. If this reload is of the single-RV intercontinental version, it may constitute a reserve force for use against the United States. One-third of the SS-20s are deployed in the Western and one-third in the Far Eastern USSR, with the last third in a swing position near the Urals. Single RVs with long range may have been preferred particularly for deployment in that area, reaching the peripheries of the Eurasian land mass from relatively invulnerable positions. The SS-20 is first and foremost a Eurasian weapon system.

The Soviet Union still operates 13 diesel-powered ballistic missile submarines of the Golf II-class, with probable deployment of six in the

[4] Some sources claim that the SS-N-12 may be given a range of 3 000 km or more, with transonic speeds rather than the usual Mach 2.5 [6].

Table 1.1. Long-range theatre nuclear missiles

Country	Missile designation	Year first deployed	Range (km)	CEP (m)	Warhead(s)	Inventory[a] A	Inventory[a] B	Programme status
USSR	SS-4 Sandal	1959	1 800	2 400	1 × Mt	350	253	Phasing out
	SS-5 Skean	1961	3 500	1 200	1 × Mt			Phasing out
	SS-20	1976/77	5 000	400	3 × 150-kt MIRV 1 × ?[b]	250	243	Production rate approximately 50 per year
	SS-N-5 Serb	1963	1 200	n.a.	1 × Mt	30	18	3 each on Golf II submarines, 6 of which have been deployed in the Baltic since 1976
USA	Pershing II	1983	1 800	40	1 × ? (low-kt)	0		108 launchers to be deployed by 1985
	GLCM	1983	2 500	50	1 × ?[c]	0		464 missiles to be deployed by 1988
UK	Polaris A-3	1967	4 600	800	3 × 200-kt MRV	64		On 4 SSBNs, being replaced by the 'Chevaline'-system, probably with 6 warheads (MRV), each of 50 kt
	Trident II D-5[d]	1990s	10 000	250	10 × 335-kt MIRV	0		Replacing the 'Polaris'/'Chevaline' system from the 1990s, probably with 64 launchers on 4 submarines
France	SSBS S-3	1980	3 000	n.a.	1 × 1-Mt	18		Conversion from S-2 to be completed by 1983
	MSBS M-20	1977	3 000	n.a.	1 × 1-Mt	80		On 5 SSBNs
	MSBS M-4	1985	4 000	n.a.	6 × 150-kt MRV	0		On the 6th SSBN; retrofit to be completed by 1989; total programme estimate: 96

[a] For the USA and the USSR, the official numbers are given. A: Figures released by the Department of State following President Reagan's speech at the National Press Club on 18 November 1981. B: Figures given by Leonid Brezhnev in *Der Spiegel*, 2 November 1981, and by Vadim Zagladin before the Fifth Pugwash Workshop on Nuclear Forces in Europe, Geneva, 11–13 December 1981.

Two-thirds of the SS-4s, SS-5s and SS-20s are estimated to be within striking range of Europe.

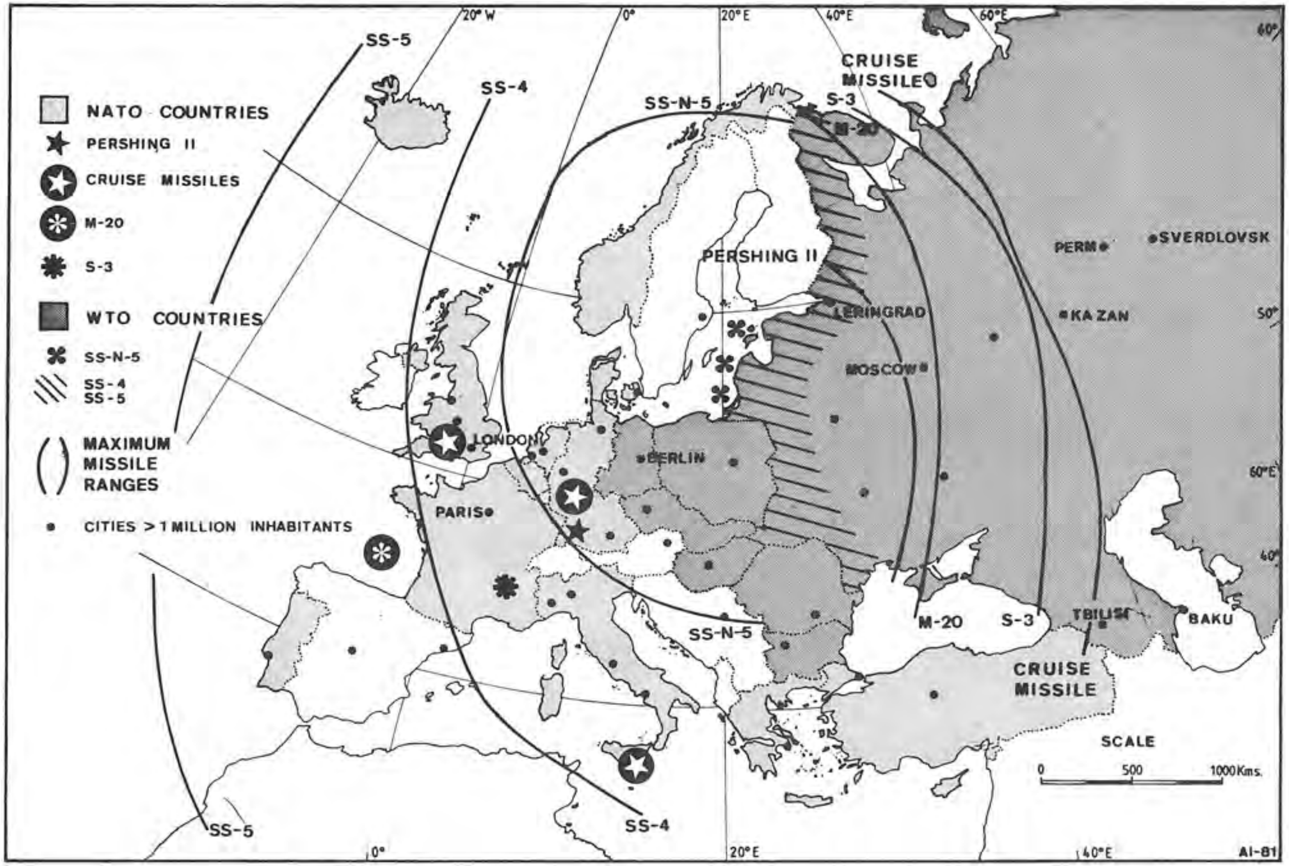
[b] Some SS-20 missiles are equipped with a single warhead and may therefore have intercontinental range.

[c] The W.84 warhead, with a low, selectable yield.

[d] The British government has not yet announced any decision regarding Trident I or Trident II (nor the number of submarines or missiles per submarine). Trident II seems the more likely because this missile will become the mainstay of the US SLBM force.

Range and yield are based on the likely US choice of warheads; since the UK will supply its own charges, it may choose other force specifications.

Figure 1.1. Deployments and maximum ranges of LRTN missiles in Europe



Baltic, four with the Northern Fleet and three in the Pacific. Each carries three SS-N-5 Serb SLBMs, with a range of 1 200 km and a megaton-yield warhead.

The NATO arsenal

The United States. The United States plans to resume its forward deployment of LRTN missiles in Western Europe with the introduction of Pershing IIs and ground-launched cruise missiles (GLCMs).

The Pershing I was operational in 1962 with a range of 650 km, later extended to 740 km for the Pershing IA. Having a CEP (circular error probability) of somewhat less than 400 m and a W.50 warhead with a variable yield of 60–400 kt, extensive collateral damage was unavoidable, while some hardened targets, such as C^3 bunkers, could not be destroyed. Development of the Pershing II began in April 1974, centred on improving accuracy through terminal guidance. In 1978 the range requirement was extended to 1 800 km, and the full-scale development contract was signed with the Martin Marietta Company in February 1979.

The accuracy achieved by the RADAG (radar area guidance) terminal guidance system is the best of any ballistic missile. In the fifth test shot, in May 1978, the warhead impacted within 25 m of the designated target. In the terminal phase, radar returns are compared with a reference image stored in the guidance computer, and position errors are then corrected. The reference image is based on the surroundings of the target, so that the missile is not deceived by camouflage or by a target buried underground [7].

Several aspects of the Pershing II—among them, the warhead—had not been finally determined by the end of 1981. Selectable yields down to 1 kt have been mentioned. Its range, accuracy and short response and flight times make it an extremely versatile and potent weapon. The pre-launch survivability is enhanced through readiness, part of the force being on quick-reaction alert; a Pershing II Firing Platoon can count down and fire three missiles simultaneously[5]; and the Automatic Reference System does not require the Pershing to be launched from presurveyed sites [8].

The USA at present operates 108 Pershing IA missile launchers in its 56th Field Artillery Brigade, the headquarters being in the southwestern part of FR Germany (three battalions of 36 launchers each in Neckarsulm, Schwäbisch-Gmünd and Neu-Ulm). The plan is to replace them with an equal number of Pershing II launchers, beginning at the end of 1983. For the Pershing IA, reload missiles exist; the same will probably be the case for the Pershing II. Plans are for the deployment to be completed

[5] The Pershing missiles are organized in battalions of 36 missile launchers, with four firing batteries (nine launchers each), each battery in turn consisting of three firing platoons (three launchers each).

by 1985; however, the first flight-test of the Pershing II extended range is not scheduled until July 1982.[6]

In addition, the West German *Luftwaffe* operates two Pershing IA wings—FKG 1 at Landsberg and FKG 2 at Geilenkirchen—each with 36 launchers. These may be replaced by the original version of the Pershing II, that is, with RADAG but without extended range, and will therefore remain in the MRTNF category.

The largest increase in the number of US nuclear warheads since MIRVing may result from the massive cruise missile programme. The air-launched (AGM-86B) and sea-launched (BGM-109 Tomahawk) versions are based on the same propulsion and guidance techniques, sharing the characteristics of long range, mobility, penetrability (flying 30 m above the ground and with a radar cross-section of 0.05 m^2, or one-thousandth that of a B-52) [10], and high accuracy (in the region of 50 m).[7] The TERCOM (terrain contour matching) guidance system—basically radar-updated inertial—may be supplemented with terminal guidance. One such system, the DSMAC (digital scene-matching area correlator) is currently being developed for the conventional land-attack version of the SLCM (the TLAM-C).

The GLCMs will be organized in so-called flights of four TELs (transporter, erector, launcher), each with four missiles. They will be housed in facilities hardened against conventional attack. Under a nuclear threat, they rely on mobility and dispersion for pre-launch survivability. The planned inventory of 464 GLCMs will be distributed as shown in table 1.2.

The GLCM programme is small compared with the deployment plans for air-launched and sea-launched cruise missiles (ALCMs and SLCMs). A total of 3 780 ALCMs are now on order [12]. The US Navy plans to procure a total of 3 994 SLCMs for land-attack and anti-ship missions, partly with conventional and partly with nuclear warheads [13]. In his October 1981 statement on strategic policy, President Reagan announced the deployment of several hundreds of nuclear-armed SLCMs on attack submarines, beginning in 1984. The Vertical Launch System will make every major US naval vessel a potential strategic nuclear factor: the eight remaining Polaris submarines may take up to 80 Tomahawks; if the battleships of the Iowa-class (BB-61) are refurbished, they may initially take 32 and later up to 320; the CG-47 Ticonderoga-class (Aegis) guided missile cruisers, 122; the DD-963 Spruance-class destroyers, 61; and the SSN-688 Los Angeles-class hunter-killer submarines, 12 each.

[6] The testing of an operational, mobile Pershing II will reportedly not take place until mid-1983. However, the RADAG guidance system is believed to have been adequately tested on the short-range version [9].

[7] Doubts have been expressed about whether the performance goals of the Pershing II and GLCM will be fully achieved [11].

Table 1.2. Planned deployment of ground-launched cruise missiles in Europe

Country	Base	Number	Year of initial operational capability
United Kingdom	Greenham Common, Berkshire	96	1984
	Molesworth, Cambridgeshire	64	1988
FR Germany	Probably Ramstein, Hahn, Spangdahlem, Brüggen and Laarbruch	96	1984
Italy	Vicenzo Magliocco, Comiso, Sicily	112	1984
Netherlands	. .	48	. .
Belgium	. .	48	. .

The United Kingdom. The four British Resolution-class SSBNs (ballistic missile submarines) were phased in from 1967 to 1969. They are equipped with 16 US-delivered Polaris A-3 missiles, each with three British-built MRV (multiple re-entry vehicles, not independently targetable) warheads with a yield of 200 kt. In order to ensure the penetration of ABM (anti-ballistic missile) defences, the United Kingdom has developed the 'Chevaline' system for its Polaris missiles, probably with six manoeuvrable warheads of 40–50 kt each. In the meantime, the Soviet Galosh ABM system around Moscow has had its missile launchers reduced from 64 to 32 [14].

The British government has decided to replace the Polaris-equipped SSBNs, starting in the early 1990s. The precise scope of this programme has yet to be decided, both as regards the number of SSBNs (four or five), the number of SLBMs per submarine (16 to 24), and the type of missile: Trident I (C-4) with eight MIRVs or Trident II (D-5) with up to 14 MIRVs (14 is the SALT II limit; technically, more are feasible). This means that the number of sea-based warheads could range from 512 to more than 2 040 warheads. A likely number is 640 (four submarines with 16 Trident IIs carrying 10 warheads each)—a tenfold increase in the number of independently targetable nuclear warheads.[8] Economic constraints, however, attach a measure of uncertainty to the whole programme.

France. Apart from the USA and the USSR, France is the only country to operate a full strategic triad of land-, air- and submarine-based nuclear weapons.

The weakest leg is the small force of silo-based missiles at the Plateau d'Albion near Avignon. One squadron has nine SSBS (*Sol-Sol Balistique*

[8] UK Defence Secretary Nott has hinted that the US decision to go ahead with the D-5 missile means that the UK almost certainly will adopt it [15].

Stratégique) S-3s, with a range of somewhat more than 3 000 km and a 1-Mt warhead. The other squadron is in the process of converting from the older S-2, with a 150-kt warhead, to the S-3.

France increasingly relies on SSBNs. The FOST (*Force Océanique Stratégique*) now operates five SSBNs, each with 16 MSBS (*Mer-Sol Balistique Stratégique*) M-20 SLBMs, with a range of some 3 000 km and a 1-Mt warhead. A sixth submarine is due to enter service in 1985 with the MRVed M-4 missile (4 000 km range, 6 to 7 150-kt warheads). The entire fleet will convert to the M-4 by 1989.[9] A seventh SSBN of a new class and with M-5 missiles—probably MIRVed—will join the fleet in 1994 at the earliest [16].

A mobile, land-based ballistic missile—the S-X—is scheduled to replace the Mirage IVA aircraft in the 1990s.

Aircraft

Aircraft have several disadvantages when compared to ballistic missiles in an LRTN role, the most significant being longer flight times, pre-launch and in-flight vulnerability. The vulnerability problem is severe for both sides: the WTO has a dense and overlapping surface-to-air missile (SAM) and interceptor network, whereas NATO, while improving SAMs, concentrates on AWACS (E-3A and Nimrod AEW) and advanced interceptors/air superiority fighters (F-15/Tornado ADV). The air defence environment is especially dense in the Central European region, which may force strike aircraft to operate to an increasing extent on the flanks [17].

On the other hand, aircraft do have certain advantages over missiles: they can carry large and diversified weapon loads, can attack several targets on the same mission—including mobile 'targets of opportunity'—can observe the results of their own strikes and those of others, can achieve high accuracy, and can be recalled after the take-off. In order to increase the range, to allow for the use of air-to-surface missiles (ASMs) (which are heavier and larger than free-fall bombs), and so on, actual weapon loads are, however, likely to be considerably lower than the potential maximum.

The comparisons presented in tables 1.3–1.7 are based on the following criteria:

(*a*) Because of the difficulties in determining the number of aircraft actually nuclear-configured, all aircraft of types that are nuclear-capable have been included.

[9] The first French SSBN, *Le Redoutable* (laid down in 1964, operational in 1971), which will come to the end of its operational life around the mid-1990s, may not convert to the M-4.

(*b*) Ranges for specific mission profiles are classified, and most sources do not specify the conditions for the ranges given. SIPRI estimates are based on the high–low–high profiles (low-level final approach to target). The possibility of in-flight refuelling has not been taken into account, although this could increase the range considerably. Most NATO aircraft are equipped for refuelling; NATO also has more aerial tankers than the WTO, and seems more proficient in using them. Combat radii are given, although the aircraft could return to other airfields than those they started from, or even be sent on a one-way mission. (For further details, see the notes to table 1.4.)

Table 1.3. Official estimates of long-range theatre nuclear aircraft in Europe

Estimates	Western aircraft		Soviet aircraft	
US figures[a]	FB-111	63[b]	Tu-22M	45
	F-111	154	Tu-16/Tu-22	350
	F-4	265	Fencer/Fitter/Flogger	2 700
	A-6/A-7	68		
Total		**560**		**3 095**
Soviet figures[a]	FB-111	65[b]	Tu-16/Tu-22/Tu-22M	461
	F-111	172		
	F-4	246		
	A-6/A-7	240[c]		
	Vulcan B.2	55		
	Mirage	46		
Total		**824**		**461**

[a] Sources are the same as those given in note *a* to table 1.1.
[b] Based in the USA, but intended for use in Europe.
[c] Presumably aircraft on US carriers in the Mediterranean Sea and the Atlantic Ocean.

(*c*) The tables list the total number of aircraft, including reserves and aircraft in training units. This leads to inflated numbers as regards aircraft actually available for any single mission, but gives comparable numbers for the WTO and NATO and is the principle used in SALT [18].

The aircraft are divided into two categories: (*a*) *primary* LRTN aircraft, with combat radii well over 1 000 km, and with a low-level, all-weather capability to ensure penetration (the Panavia Tornado (MRCA) has, for instance, been put in this category because of its excellent low-altitude, all-weather capability, although its range would more properly place it in category *b*); and (*b*) *marginal* LRTN aircraft, with combat radii of about 800–1 200 km, and a limited low-level, all-weather capability. The F-16 Fighting Falcon has been placed in this category, *inter alia*, for lack of an all-weather capability.[10]

[10] From the mid-1980s, F-16s will be equipped for day/night all-weather operations, with navigation/target location from satellite or aircraft. In addition, there are plans for an extended-range version, the F-16E (XL), with all-weather capabilities [19].

Table 1.4. Primary long-range theatre nuclear aircraft

Country	Designation	Year first deployed[a]	Combat radius (km)[b]	Inventory[c]		Programme status
				Total	European[d]	
USSR	Tu-22M Backfire	1974	3 000	75	60	Production rate: up to 30 per year, half of them assigned to naval aviation
	Tu-16 Badger	1955	2 000	300	225	
	Tu-22 Blinder	1962	1 200	130	100	
	Su-24 Fencer	1974	1 700	500	375	Production rate: approx. 60 per year
USA	FB-111A	1969	1 800	63	0	
	F-111A/D/E/F	1967	2 000	300	156	
UK	Vulcan B.2	1957	2 700	55	55	Being replaced by Tornado
	Tornado GR.1 (IDS)[e]	1982	1 400	0	0	220 programmed (incl. 68 dual-control trainers); last 20 may be converted to F.2 (ADV)
France	Mirage IVA	1964	1 600	35	35	More than 15 will continue in service after 1985
	Mirage 2000N	1986	1 400	0	0	Up to 200 may be acquired.
Rest of NATO	Tornado IDS	1982	1 400	0	0	FR Germany plans 212 (incl. 47 dual-control trainers); Italy plans 100 (incl. 12 trainers)

[a] Date for deployment of first version in country of origin.

[b] Ranges assume a high–low–high mission profile (with low-level, high-speed final approach to the target), maximum external and internal fuel, but no in-flight refuelling, and that the payload includes external nuclear ASMs where applicable. The ranges of the ASMs are, however, not added to that of the aircraft.

The given ranges are *maximum* combat radii, which might be reduced by the need for evasive action, fuel reserves (for landing and loiter), external ECM equipment (which reduces fuel load and increases aerodynamic drag), more demanding mission profiles to increase penetration and survivability, etc.

[c] Numbers given are total, i.e. including all aircraft of types that are considered dual-capable, covering aircraft in the maintenance cycle.

Trainers are excluded (save dual-control versions of aircraft that are two-seaters in their basic version), and reconnaissance aircraft (unless they are basic versions equipped with pods).

Actual numbers of nuclear-configured, mission-ready aircraft are substantially lower.

[d] Aircraft based in Europe or within striking range of targets in Europe without refuelling. For the USSR, this is estimated at three-quarters of the total.

[e] Tornado GR.1 is the British designation of the Panavia Tornado IDS (interdiction/strike version). The United Kingdom also plans to acquire 165 of the air defence variant (ADV) of the Tornado, with the official designation Tornado F.2.

Table 1.5. Marginal long-range theatre nuclear aircraft

Country	Designation	First deployed[a]	Combat radius (km)[b]	Inventory[c] Total	European[d]	Programme status
USSR	MiG-23/27 Flogger	1971	900	2 000[e]	1 500	Production continues at 500 per year (incl. exports)
Rest of WTO	MiG-23 Flogger	1971	900	200	200	
USA	F-16 Fighting Falcon	1979	1 300	300	0	Total programme: 1 388 (incl. 204 F-16B trainers); more than 200 will be deployed in Europe
	F-4 Phantom II	1961	1 100	1 400	250	Being phased out of active duty and transferred to the Reserve Force
	A-7 Corsair II	1966	1 200	370	0	Reserve Force
UK	Buccaneer S.2	1962	1 400	60	60	Excl. 20 in maritime strike role (cf. table 1.6)
	Jaguar GR.1	1973	1 200	140	140	Excl. 30 Jaguar T.2 trainers
	Harrier GR.5 (AV-8B)	1986	900	0	0	Total programme: 60
France	Jaguar A	1973	1 200	160	160	Total number procured (losses unknown); excl. 40 Jaguar E trainers
	Mirage IIIE	1961	1 000	135	135	Being phased out; excl. 14 Mirage IIIBE trainers
Rest of NATO[f]	F-16 Fighting Falcon	1979	1 300	64	64	Excl. 8 F-16B trainers; total programme: 194 F-16A (of which 4 have been lost) and 46 F-16B (2 lost)
	A-7H/P Corsair II	1966	1 100	63	63	Excl. 6 TA-7H trainers; 11A-7P on order for Portugal
	F-4E Phantom II	1961	1 100	134	134	Incl. 10 West German F-4E in USA for training; excl. 96 RF-4E and 168 F-4F
	F/CF-104G Starfighter	1958	1 000	555	525	Incl. 30 West German F-104G in USA for training; excl. 145 TF-104G and RF-104F; being phased out
	F-104S (Aeritalia)	1969	1 000	196	196	

[a] Date for deployment of first version.

[b] Ranges assume a high–low–high mission profile (with low-level, high-speed final approach to the target), maximum external and internal fuel, but no in-flight refuelling, and that the payload includes external nuclear ASMs where applicable. The ranges of the ASMs are, however, not added to that of the aircraft.

The given ranges are *maximum* combat radii, which might be reduced by the need for evasive action, fuel reserves (for landing and loitering), external ECM equipment (which reduces fuel load and increases aerodynamic drag), more demanding mission profiles to increase penetration and survivability, etc.

[c] Numbers given are total, i.e., including all aircraft of types that are considered dual-capable, covering aircraft in the maintenance cycle.

Trainers are excluded (save dual-control versions of aircraft that are two-seaters in their basic version), and reconnaissance aircraft (unless they are basic versions equipped with pods).

Actual numbers of nuclear-configured, mission-ready aircraft are substantially lower.

[d] Aircraft based in Europe or within striking range of targets in Europe without refuelling. For the USSR, this is estimated at three-quarters of the total.

[e] Including 600 MiG-27 Flogger Ds, but excluding some 1 000 MiG-23s in the air defence force (*PVO-Strany*), which are not considered to be nuclear-capable.

[f] Excludes Canadian, Danish and Norwegian aircraft, which are unlikely to be converted to nuclear roles.

Table 1.6. Naval long-range theatre nuclear aircraft

Country	Designation	Year first deployed[a]	Combat radius (km)[b]	Inventory[c]		Programme status
				Total	European[d]	
USSR	TU-22M Backfire	1974	3 000	75	60	Naval aviation has received half the number of Backfires
	TU-16 Badger	1955	2 000	250	190	
	TU-22 Blinder	1962	1 200	50	35	
USA	A-6 Intruder	1963	1 500	250	20	
	F-18 Hornet	1982	1 100	0	0	Total programme: 1 377 (including TR-18 trainers)
	A-7 Corsair II	1966	1 200	360	48	Being replaced by F-18
	F-4 Phantom II	1961	1 100	200	0	Excl. 200 non-nuclear Marine Corps F-4s; being replaced by F-18s
	AV-8B Harrier II	1985	900	0	0	Total programme: 322
UK	Buccaneer S.2	1962	1 400	20	20	Approx. number dedicated to CINCLANT; will continue for some time after the rest of the Buccaneers are replaced by Tornado IDS
France	Super Etendard	1979	700	60	60	The 300-km range of the ASMP will give it marginal long-range theatre nuclear capability; total programme: 71
FR Germany	Tornado IDS	1982	1 400	0	0	Total programme: 112 (including 10 dual-control trainers)
	F-104G Starfighter	1958	1 000	95	95	Excl. 10 TF-104G and 24 RF-104G; being replaced by Tornado

[a] Date for deployment of first version in country of origin.

[b] Ranges assume a high–low–high mission profile (with low-level, high-speed final approach to the target), maximum external and internal fuel, but no in-flight refuelling, and that the payload includes external nuclear ASMs where applicable. The ranges of the ASMs are, however, not added to that of the aircraft.

The given ranges are *maximum* combat radii, which might be reduced by the need for evasive action, fuel reserves (for landing and loitering), external ECM equipment (which reduces fuel load and increases aerodynamic drag), more demanding mission profiles to increase penetration and survivability, etc.

[c] Numbers given are total, i.e., including all aircraft of types that are considered dual-capable, covering aircraft in the maintenance cycle.

Trainers are excluded (save dual-control versions of aircraft that are two-seaters in their basic version), and reconnaissance aircraft (unless they are basic versions equipped with pods).

Actual numbers of nuclear-configured, mission-ready aircraft are substantially lower.

[d] Aircraft based in Europe or within striking range of targets in Europe without refuelling. For the USSR, this is estimated at three-quarters of the total. For the USA, aircraft on board 2 carriers (2 Carrier Air Wings) have been included.

Table 1.7. Air-to-surface missiles[a]

Country	Designation	Year first deployed	Range (km) (high-level launch)	Warhead	Speed (Mach)	Inventory	Notes, programme status
USSR	AS-2 Kipper	1961	210	1 × kt-range/HE	1.2	n.a.	1 × Tu-16
	AS-4 Kitchen	1962	720	1 × kt-range	2.5	135	1 × Tu-22 2 × Tu-22M
	AS-6 Kingfish	1977	700	1 × 200-kt	3	65	1 × Tu-16 2 × Tu-22M
USA	AGM-69A SRAM	1972	160	1 × 170-kt	3	378[b]	6 × FB-111A
France	ASMP	1985	300	1 × 150-kt	3	0	1 × Mirage IVA (1985) 1 × Mirage 2000N (1986) 1 × Super Etendard (1987) Total programme: 100

[a] Nuclear-capable ASMs being used on LRTN aircraft.

[b] Maximum force loading for the FB-111A. Total SRAM inventory 1 250.

The use of ASMs may significantly increase the penetration capability of aircraft systems. This is especially important for old, vulnerable aircraft such as the Soviet Tu-16 and Tu-22. In addition, ASMs increase the range of the systems; thus, the French Super Etendard carrier-based naval aircraft achieves a range that puts it in the marginal LRTN category when using the 300-km range ASMP (*Air-Sol Moyenne Portée*) missile. France will equip its Mirage IVA, Mirage 2000 N and Super Etendard aircraft with this missile. The USA operates the short-range attack missile (SRAM) on its FB-111As, and may develop a relatively short-range cruise missile to fit smaller aircraft. The technical feasibility of equipping the Tornado with cruise missiles has been explored [20].

The WTO arsenal

Primary LRTN aircraft. The Soviet Long-Range Aviation (LRA) operates several hundred medium-range bombers, the most numerous of which is still the Tu-16 Badger. In terms of capabilities it may be compared to the US B-47, which was phased out in the mid-1960s. Badgers can be expected to remain in service until about the end of this decade, though increasingly converted to reconnaissance, electronic countermeasures (ECM) and tanker configurations. Some 300 Badgers are currently in service in the bomber role, with another 100 or so in support roles. In addition to the Badgers, the LRA operates some 130 Tu-22 Blinders, also approaching obsolescence.

The Soviet LRTN bomber force is increasingly based on the Tu-22M Backfire. The combat radius of the Backfire bomber is sufficient to reach any European target from bases in the Soviet Union, but it may have to depend on ASMs to deliver its weapons to the target. About 75 are operational with the LRA forces.

One of the most important developments in the Soviet aircraft arsenal is the steady increase in the number of Su-24 Fencers, which have capabilities that place them somewhere between the Tornado and the F-111. Some 500 Fencers are operational so far, and production continues at a rate of 60 or more per year. None is based outside the Soviet Union.

Marginal LRTN aircraft. The MiG-23/27 Flogger is becoming the standard Frontal Aviation fighter. The number of Floggers in service is increasing very rapidly, more than 500 being produced every year (including those for export). Today, some 2 000 Floggers are operational, including 600 of the MiG-27 Flogger D ground-attack version. However, when considering the LRTN potential for the large Flogger force, it should be borne in mind that it has a limited all-weather capability, and that even the MiG-27 versions are range-restricted and primarily intended for close support of ground forces. Other WTO countries are also phasing in the MiG-23, mostly the MiG-23BM Flogger F, which is a somewhat simplified export version of the MiG-27 Flogger D. So far, these countries have some 200 of them.

Western estimates of the LRTNF balance often include other dual-capable aircraft as well, such as the MiG-21 Fishbed and the various Fitter versions (Su-7/17/20). Even the most long-ranged of these, the swing-wing Su-17/20, has an operational combat radius that excludes it from LRTN calculations.

Finally, some allowance for Soviet Naval Aviation forces seems justified. While primarily intended for anti-ship roles, their potential for land attack is obvious. Some 75 Tu-22Ms (half of the Backfire force), 250 Tu-16s, and 50 Tu-22s have been assigned to Naval Aviation.

The NATO arsenal

The United States. The US Air Force in Europe (USAFE) has 500 combat aircraft at its disposal. The most potent LRTNF component is the two F-111 wings based in the UK, with 66 F-111Es and 90 F-111Fs. Other dual-capable aircraft based in Europe, in the marginal LRTNF category, include some 250 F-4 Phantoms—with the F-16 being phased in.

In times of crisis or war, these forces can be greatly expanded by transfer of CONUS-based aircraft to 43 Collocated Operating Bases and 14 Main Operating Bases in Europe, amounting to a total of 960 combat aircraft, and another 592 if bases are available [21].

The total US inventory figures include aircraft already in Europe, those based in Asia, as well as Air Force Reserves and the Air National Guard. The transfer of aircraft from Asia is a remote possibility, while the general significance of Reserves and National Guard forces is increasing.

Regarding the number of CONUS-based F-111s that are available for European contingencies, it is assumed that at least 144 F-111A/Ds still exist. Ninety-six of them are declared to be in active service. Of the strategic FB-111A version, 63 aircraft exist. These are not SALT-accountable, and are clearly intended for missions in Europe. Both sides include them in their LRTNF estimates.

The Phantom is being transferred to the reserves while the F-16 Fighting Falcon is being phased in; of a total production order of 1 182 (and another 206 F-16B dual-seat trainers), some 300 have been delivered. The 370 A-7D Corsair IIs are all in the Reserve Force.

In US naval aviation, the F-18 Hornet will become the standard fighter aircraft in the years ahead (supplemented by the F-14A Tomcat in the air defence role). It replaces the A-7E Corsair II and the F-4 Phantom II. The all-weather-capable A-6 Intruder will be maintained for long-range strike missions. The AV-8B Harrier II is scheduled to become operational in 1985.

The United Kingdom. The 55 Vulcan B.2 will be replaced at a rapid rate by the Tornado GR.1, which is entering service from 1981–82. The same applies to the Buccaneer S.2. By 1986, all Vulcans and Buccaneers should have been replaced by the Tornado interdiction/strike version. Jaguar GR.1 aircraft are also nuclear-capable, entering the marginal LRTN category.

France. The longest-serving leg of the French strategic nuclear triad is the Mirage IVA, with a total of 62 delivered by 1968. Thirty-five remain in the bomber role (including two in reserve). They are supported by 11 KC-135F aerial tankers. More than 15 Mirage IVAs will be kept beyond 1985, re-equipped with the ASMP stand-off missile in exchange for its present AN-22 free-fall 70-kt bomb.

The Tactical Air Force operates Jaguar A and Mirage IIIE aircraft, the nuclear-dedicated version carrying a single AN-52 free-fall 25-kt bomb. These are marginal LRTN aircraft. The strike version of the next-generation fighter, the Mirage 2000N, armed with ASMPs, will replace the Mirage IIIE from 1986–87, and is considered to be a primary LRTN aircraft.

Other NATO countries.[11] The most important LRTN aircraft in the other NATO countries is the F-104G Starfighter, especially for FR Germany. The Starfighter, which was introduced in the early 1960s, is now being replaced by the Tornado (in FR Germany and Italy), and the F-16 (in Belgium and the Netherlands), but will remain in service for some time in Greece and Turkey.

Canadian, Danish and Norwegian aircraft are not taken into account, as they are unlikely to be converted to nuclear configuration.

Force ratios

As far as weapon systems within striking range of Europe are concerned, the force ratios are roughly as follows.

In the missile sector, the Soviet Union has a predominance in the number of launchers, of the order of 2.5:1 (if US figures are accepted) or 2:1 (using Soviet numbers). The disparity appears in the figures for the remaining SS-4s and SS-5s.

For primary LRTN aircraft (including CONUS-based FB-111As), the ratio is 2.5:1, for a WTO advantage. The inclusion of naval aircraft does not change that ratio significantly. Towards the end of the decade, this numerical advantage is likely to be somewhat reduced—even with the continued production of Backfires and Fencers at present rates—as the

[11] Spain will probably join NATO, which will add the following dual-capable aircraft: 19 Mirage III-EEs (plus six trainers) and 37 F-4C Phantom IIs. On the other hand, Greece may withdraw its participation in NATO's nuclear posture.

Tornado enters service and the Tu-16/22s reach the end of their serviceable lifetime.

There are wide disparities in the official figures for the aircraft sector. Apart from the public relations debate over numbers that came to a head before the opening of the Geneva negotiations and other tactical considerations which enter into the calculations, the disparities reflect a variety of difficulties in counting LRTN aircraft. There is bound to be a certain arbitrary element in any estimate.

If warheads are counted, the Soviet Union has a much greater predominance in the missile sector, as long as British and French forces are not MIRVed. For aircraft, weapon loads are too flexible and uncertain for overall estimates to be meaningful.

IV. Theatre nuclear doctrines

Soviet LRTNFs, in particular the SS-20, have created a sense of inferiority and insecurity in Western Europe and may be used for purposes of intimidation and blackmail. In times of war, Soviet doctrine emphasizes initiative, surprise, deep strikes and massive use, which can now be executed with greater precision than before. It is small comfort that this has been the Soviet doctrine for 20 years, that Western Europe has lived under the shadow of Soviet LRTN missiles ever since the end of the 1950s or beginning of the 1960s, and that to some extent the threat was only 'rediscovered' in 1977 with the deployment of the SS-20s and the general deterioration of East–West relations.

An historical perspective is indispensable for any assessment of the political and military functions of these systems. While gross Soviet inferiority in intercontinental systems and the 'holding Europe hostage'-factor belong to the past, Soviet LRTNFs are still opposing US forward-based systems. The FBSs have been on the decline for some time, but may again increase considerably through the deployment of Pershings and the wide dispersal of cruise missiles. In addition, French, British and Chinese forces are growing. The Soviet Union has a number of regional security concerns, each with its own specific military aspects.

In all likelihood, a domestic momentum of an industrial, a bureaucratic and a military nature has also influenced the genesis and scale of present programmes, giving the Soviet Union a current numerical lead of more than 2:1 in LRTN systems within striking range of Europe. In the West, where much higher ratios are mentioned, this has produced considerable concern and anxiety—all the more so since, in political life, there is often no strict relationship between cause and effect. Nor are history and the international context always properly taken into account.

The High Level Group (HLG), established by NATO in October 1977 to study the need for new LRTNFs, agreed that NATO's modernization decision should reflect an evolutionary change in the alliance's posture, with no change in nuclear strategy and no change in the overall number of nuclear weapons in the European theatre [22]. The deployment would not be required to match the number of SS-20s and other Soviet LRTN systems, but should be sufficient to keep open the option of striking a substantial number of Soviet targets from Western Europe, the military/technical judgement being that existing forces were no longer adequate for that purpose. Hence, the military rationale for new missiles was based on the need to enhance the coupling between theatre forces and US intercontinental systems, reinforcing the US nuclear umbrella over Western Europe. It was undoubtedly a response to Soviet modernization as well, but politically more than militarily, providing bargaining leverage for negotiations with the Soviet Union [23]. In public discussions, the need for new LRTNFs has largely been ascribed to the Soviet build-up of SS-20s and Backfire bombers. This is superficial: rather, the SS-20 has been singled out for particular attention to justify a perceived need to modernize which, sooner or later, would have arisen in any case [24].

Making the SS-20 the big public argument for new cruise and Pershing missiles is a double-edged sword. To emphasize the SS-20 as a source of insecurity and potential blackmail to the extent that some political leaders have done amounts to declaring oneself open to pressure already in advance. In this connection, it may be worthwhile recalling that self-fulfilling prophecies are not uncommon in politics [25]. On the other hand, if West European politicians declare that they are not susceptible to nuclear blackmail, it is not clear what the Soviet Union could blackmail Western Europe into doing. The whole blackmail theory needs a serious examination [26].

Soviet military doctrine starts from the premise that if another war occurs in Europe, it should be fought as far towards the West as possible. Nuclear, chemical and conventional weapons are highly integrated, and Soviet strategic literature does not emphasize the selective use of nuclear weapons and the limitation of collateral damage as NATO declaratory strategy does. Generally, the logic of Soviet military doctrine seems coherent. NATO doctrine, however, is based on premises which have been heavily criticized for lack of consistency and credibility.

The military-strategic rationale for new NATO missiles

The official military-strategic justification for the deployment of cruise and Pershing missiles in Western Europe hinges on the 'coupling' argument and the maintenance of the US nuclear umbrella over Western

Europe. In the following sections, an attempt is made to examine these arguments by first elaborating, in some detail, two alternative rationales for the new missiles along those lines—without pretending that Western defence officials would subscribe to all of it—and then assessing the validity of the assumptions.

If cruise and Pershing missiles are forward-based in Western Europe, pressure will arise to fire them before they are captured or destroyed, or in retaliation to a Soviet attack with similar weapons. Both cruise and Pershing missiles would reach targets on Soviet territory. With a range of 1 800 km, the Pershing missiles would reach almost as far as Moscow from their deployment positions in the Schwäbisch-Gmünd–Neu Ulm–Neckarsulm area.[12] There would, in other words, be a US nuclear attack on the Soviet Union, the likely response to which is Soviet retaliation against US territory, that is, the escalation of warfare to the strategic level. This is consistent with traditional West German and other NATO declaratory policy: for the European countries, nuclear weapons are primarily political weapons—their only rational function being that of dissuasion by deterrence—and a credible threat of rapid escalation to the strategic level would be the most effective deterrent. Cruise and Pershing missiles serve precisely that function because they will couple the theatre nuclear forces with the intercontinental systems of the United States. Therefore, the US nuclear umbrella over Western Europe—questioned ever since the advent of Soviet intercontinental missiles, and increasingly so as the Soviet Union achieved rough nuclear parity—would be re-inforced or re-established.

Land-based missiles are, furthermore, more effective in the coupling role than sea-based missiles would be. Submarine-based weapons could be held in relatively invulnerable positions for long periods of time, so the pressure to use them at an early stage might be less and the escalatory effect therefore more uncertain. Moreover, land-based missiles are more visible than sea-based ones and therefore also more credible couplers of US and European destinies in the public eye. This psychological-political argument loomed high in the justification for land-basing before the so-called dual-track decision was made on 12 December 1979.

The basing areas in FR Germany are such as to maximize the coupling effect. Like the Pershing II, the cruise missiles will move around in the western parts of FR Germany; if the scenario is that of a European war between the two alliances, it is therefore reasonable to assume that nuclear weapons will already have been used before Soviet forces eventually reach the deployment areas of cruise and Pershing missiles, that is,

[12] Awaiting flight-testing of the extended-range version, the precise range of the missile is not known. A further developed version of the Pershing with a range of about 4 000 km is in "technology development", but so far under limited funding.

before they have to be fired.[13] The first use of nuclear weapons—a very hard decision to make—is therefore likely already to have occurred, and the further use of nuclear arms is usually assumed to be less difficult to authorize. Since the launching of cruise and Pershing missiles is not likely to be a question of first use, the firing of them becomes more thinkable and, consequently, more likely actually to happen. Seen from the USSR, the threat of retaliation against Soviet territory therefore becomes more credible and the deterrence effect all the more formidable —or so the reasoning goes.

The deterrence threat of retaliation against Soviet territory may also be enhanced in another way. It is sometimes hypothesized that it may work in this manner: if highly accurate nuclear missiles are launched against the USSR from Western Europe, the Soviet Union would retaliate against Western Europe and not against US territory, for fear that its less accurate missiles would lead to an all-out strategic war if launched against the United States. And the more likely it becomes that Soviet retaliation will be directed against Western Europe, the higher the probability is that the USA will actually use the new cruise and Pershing missiles against targets on Soviet soil. Thus, Soviet territory would not be a sanctuary in a European war. The Soviet leaders would know from where the attack is launched—and by implication, also where to retaliate. This proposition is clearly incompatible, however, with the rationale outlined above.

A key factor in this line of reasoning is high accuracy. The CEP for Pershing and cruise missiles is only about 40–50 metres, so even with a low-yield nuclear warhead, the Pershing will be a very effective counterforce weapon, and the collateral damage may be relatively low. The Soviet Union, which is unable to retaliate with similar high-accuracy, low-yield weapons against US territory, may therefore respond by turning its less accurate weapons against Western Europe. In this case, Western Europe would be the hostage and eventually the victim of a US nuclear attack on the European part of the USSR—a situation similar to that which existed before the advent of Soviet intercontinental forces, when Soviet LRTNFs were deployed to compensate for the 'missile gap' (which was real enough, but in the US favour). The other edge of this deterrent sword is therefore the Europeanization of nuclear war on US terms.

This is not the first time the United States has tried to capitalize on its lead in missile accuracy to bolster the European belief in the nuclear umbrella. When former Secretary of Defense Schlesinger presented his nuclear weapon targeting and employment policy in 1974—spelled out in

[13] In most of the war game scenarios played out by NATO, 8-in howitzers and 155-mm batteries are fired first [27].

National Security Decision Memorandum 242—the selective use of strategic weapons against Soviet territory was one of the new features. The selective options were justified by reference to the need to reinforce the umbrella over Europe [28]. Schlesinger preferred Minuteman ICBMs for execution of such options; SLBMs might have been as accurate (*inter alia* because of shorter flight distance to target) but not as reliable. Anyhow, accuracy was a key factor in the strategy of selective options, and since the USSR could retaliate only by means of less accurate missiles with higher-yield warheads, it was assumed that the selective options strategy was credible. An attack on Western Europe could, in other words, lead to the use of US strategic weapons in a selective mode. In conclusion, the strategy would create a stronger link between TNFs in Europe and US intercontinental systems, thereby enhancing deterrence.

The new feature in relation to the cruise and Pershing missiles is, therefore, not the effort to capitalize on the lead in missile accuracy, but the forward basing of the missiles in FR Germany, Italy, the United Kingdom, and eventually other European countries. Land-basing is more visible than sea-basing also in the sense that the Soviet Union will be in a better position to determine which types of forces are used, namely, LRTNFs from Western Europe or strategic forces from the sea, covered by SALT. This fits the second deterrence mode mentioned above, insofar as it makes it easier to distinguish the beginning of a theatre nuclear war in Europe from the start of a strategic nuclear exchange between the two great powers.

The first line of thought centres on the coupling effect, and largely confirms the NATO military-strategic rationale for deploying new missiles in Europe. The other one emphasizes that a nuclear umbrella may be achieved by means of highly accurate theatre weapons, drawing the western districts of the USSR into the war area while avoiding retaliation against US territory. How credible are they?

The 'nuclear umbrella': the remarkable life of a myth

The role of nuclear weapons in the defence of Western Europe has been problematic ever since the Soviet Union achieved a potent second-strike capability *vis-à-vis* the United States. When deciding to remove France from NATO's military organization, de Gaulle argued that no US President would sacrifice Chicago for Paris. The umbrella was gone. At the time, his judgement was disputed. However, with the advent of strategic parity, more and more politicians and observers drew the conclusion that the nuclear umbrella of the 1950s had become fiction.

For the Soviet leadership, the detonation of a US nuclear weapon on Soviet territory is certainly an act of strategic nuclear warfare. The planned response can hardly depend on the launching point or such physical characteristics of the delivery vehicle as accuracy. Retaliation against US territory must be assumed to follow. Otherwise, the implication is that the Soviet leaders would, in effect, signal to the USA: "Our homeland is divisible: if you shoot at us West of the Urals from Western Europe we will leave your territory intact, but not if you use Poseidon or Minuteman missiles". Not that retaliation against the USA, with the inherent danger of escalating strategic warfare, is necessarily a rational reaction. But the US government can hardly be expected to gamble on the possibility that the Soviet leaders would scrap their planned response and switch to another standard of rationality at the moment of showdown.

In all likelihood, the nuclear umbrella over Western Europe is just as fictitious as Henry Kissinger said it was in his speech in Brussels in 1979 [29]. In fact, all umbrellas seem to be gone, and the one over Western Europe may have been the last one to fold up. No technological fix is likely to revive it. Thus, in response to Schlesinger's selective options, the Soviet Union probably prepared measured counter-attacks against US territory, for instance, detonation of a similar number of nuclear warheads over deserts or sparsely populated areas, to avoid great damage to cities and industrial centres, thereby limiting the escalatory effect of the response. Launching cruise and Pershing missiles from Western Europe makes no basic difference: this would still be a nuclear attack on the Soviet homeland—and a dramatic act of irrationality, since retaliation against the USA is likely to follow. Therefore, neither the one nor the other of the above-mentioned coupling and umbrella assumptions holds water. On the contrary, to use the new missiles against the Soviet Union, and consciously escalate the war to a strategic level, is something the USA would do its utmost to prevent: if there is anything worthy of being called supreme national interest, it must be the desire to keep one's own country outside the area of direct nuclear warfare. To launch an attack from Western Europe on the assumption that the Soviet Union would then conveniently retaliate against Western Europe and the US forces there, rather than against US territory, is therefore wishful thinking, and so obviously so that US decision makers must have clearly understood this for a long time. There is never going to be a mutual understanding between the two great powers on confining a nuclear war to Europe between the Atlantic and the Urals, leaving the United States as a sanctuary.

A European theatre comprising all European countries and excluding the Soviet Union and the USA (which is a European power by invitation) is another matter. Should a war break out between the military alliances in Europe, both the great powers would, of course, do their very best to keep their own territories out of it. Here, the logic is overwhelming; we do not have to read public statements or war manuals to know that this is so. Precisely because the logic is so compelling, there is no need for US–Soviet talks to establish agreement on it either. That commonality of interest works perfectly well by tacit understanding. This is, *nota bene*, not to say that a nuclear war in Europe will actually be so confined—only that the USA and the USSR will try to confine it. No one can know whether they will succeed: technological mishaps, a chaotic battlefield, the breakdown of C^3I facilities and human behaviour under extreme stress defy prediction.

Nor is an ambitious US strategic programme likely to reinstate the nuclear umbrella. Admittedly, the Reagan Administration is aiming at some kind of clearly perceived upper edge in this decade. Depending on the degree and kind of strength that will be achieved, perceptions of US aims, plans and readiness for action are likely to change, and more assertive US behaviour in various parts of the world might be expected. But to reinstate the umbrella—that is, to make it sound realistic that the USA would use, for example, cruise and Pershing missiles against the Soviet Union in defence of Western Europe—much more is needed. The relationship between the two great powers would have to revert to that which existed at the time of the Cuban missile crisis, and this is out of the question.

Suffice it then to add that, apart from first use, the decision to launch nuclear weapons against the major adversary is likely to be the hardest one to make in a nuclear war. For the Soviet Union to try to capture or destroy cruise and Pershing missiles, or to use its LRTNFs against Western Europe in the massive, deep-strike fashion prescribed by Soviet doctrine, would certainly also be a very dramatic act. However, from a great-power point of view, it would be less consequential than escalation to the strategic level. No US superiority is likely to change this in the foreseeable future.

In conclusion, two deterrence effects of new missile deployments nevertheless remain.

1. The missiles will, after all, add some uncertainty regarding Western responses to a WTO attack, and therefore induce additional caution on the Soviet side. Thus, the postulated coupling effect cannot be entirely discarded. This should be all the more emphasized since a number of Soviet statements allude to the view that a nuclear war in Europe will trigger the use of LRTNFs against the Soviet Union, and quickly escalate to the strategic level.

2. More effective coverage of military targets in the smaller East European countries, of Soviet forces, bases and support facilities in particular, also has a deterrent effect. (Apart from GLCMs and Pershing

IIs, this deterrent effect is enhanced by the current modernization of NATO MRTNFs.)

However, with these modifications, the postulated coupling effect basically appears to be a myth.

V. The role of cruise and Pershing missiles in US strategy

Targeting and employment policies

Would there not be pressure on the United States, after all, to fire the missiles before they are captured or destroyed, or in retaliation to a Soviet attack by similar weapons? The answer is yes—the pressure would no doubt be real. So, granted that it is a gargantuan task to prevent a nuclear war in Europe from escalating to the strategic level, why does the United States invest so much—first of all politically, but also economically—to deploy new missiles in Western Europe? What is the point, in terms of *US* interests? What is the *US* military-strategic rationale for wanting the new weapons deployed?

The answer seems simple. Should the scenario be that of a European battle, the missiles might well be fired—but most likely against the smaller East European countries, and preferably against Soviet forces, bases and support facilities there. Technologically, using them that way poses no problem: both cruise and Pershing missiles can be used over short as well as long distances. If the scenario is not a European battle but a direct confrontation between the major powers involving their intercontinental systems, then cruise and Pershing missiles in Western Europe would be available for use against the Soviet Union in accordance with US strategic warfare plans.

Following this line of reasoning, the *targeting policy* for the cruise and Pershing missiles will comprise alternative sets of targets, tailored to different war scenarios. In a European battle, the missiles are likely to be directed at Eastern Europe; in a strategic exchange, at the Soviet Union.[14] They would figure in US strategic planning as well as in NATO's nuclear warfare plans. A historical precedent for such a solution might be recalled: the Mace B 2 500-km range cruise missiles deployed in FR Germany in the period 1962–69 were reportedly targeted by SACEUR against East European countries and by SAC against the Soviet Union [30]. If there is one reload per SS-20 launcher, and one of the missiles is a single-RV version with intercontinental range, some targeting flexibility of a similar kind may exist also for the Soviet Union.

[14] Pershing II targeting lists may, for instance, include targets allotted to the Pershing IAs that are replaced.

By fixing alternative sets of targets, a targeting policy for the new missiles may therefore be agreed upon. But a mutually agreed *employment policy* (specifying under which circumstances and for what purposes the missiles should be used) is much less likely to see the light of day. That has always been provisional, procedural or unfinished business with NATO's Nuclear Planning Group (NPG).

While politically related to questions of alliance cohesion, the main US military rationale for the new missiles therefore appears to be strategic. The Pershing II will be one of the most capable counterforce weapons in the US arsenal should it ever be deployed in Europe: the RADAG system allows it to home on to virtually any kind of fixed target; no effective defence against it exists; and the flight time would be 12 minutes or less, depending on the distance to target. The flight time for Soviet LRTN missiles is correspondingly short. At worst, this may become another argument for adopting launch-on-warning strategies, which would increase the danger of nuclear war by accident.

The modernization decision and the countervailing strategy

The preparations for the 12 December decision and the elaboration of the countervailing strategy, laid out in Presidential Directive-59 (PD-59, of July 1980), took place in parallel. Little is known about the relationship between the two.

Generally, the countervailing strategy seems to have taken existing US strategy a few steps further, representing continuity rather than radical new departures. It requires that US forces not only maintain the capability for assured destruction of the Soviet Union, but also have "the capability for flexible, controlled retaliation against a full range of targets for any attack at any level" and, in so doing, confirms the changing direction of strategic doctrine that has evolved over a number of years [31].

PD-59 placed stronger emphasis on the capability to destroy military and political C^3I facilities, and raised a great demand for new weapons capable of knocking out hard targets. Cruise and Pershing missiles were technologically close at hand; they are both suitable for hard-target missions, and the Pershing II is ideal for use against time-urgent targets. Speeding up cruise and Pershing programmes was therefore a logical response to the new requirements as defined by the countervailing strategy. In this way, two endeavours pursued for their own reasons may, in effect, have become mutually reinforcing. This may partly explain why the Carter Administration—which initially stressed that the United States had more than a sufficient number of intercontinental systems to cope with the Soviet theatre threat—switched to a position of strong support for new deployments in Europe. The breakthrough for the introduction of the new missiles on European soil apparently came at the four-power summit meeting at Guadeloupe in January 1979, on President Carter's proposal.

In reviewing the capabilities of existing US intercontinental systems in relation to the requirements defined by the countervailing strategy, the Comptroller General concludes that only bomber-delivered weapons—from the FB-111A bomber—have the necessary combination of yield and accuracy to destroy efficiently super-hardened targets while limiting collateral damage. Of the near-term programmes, only ALCMs have the required accuracy/yield combination [31]. Although not reviewed in the report, it goes without saying that the GLCM is similarly suitable for such missions. However, for limited nuclear strikes, weapons which can destroy assigned targets with certainty while minimizing collateral targets are required: because it is vulnerable, the cruise missile is less well suited for this purpose. The Pershing, on the other hand, has superior characteristics for limited strikes, almost regardless of the hardening of the target, and is ideal against time-urgent targets.[15] The weapons planned for Europe therefore fit the requirements of PD-59 very well.

However, in relation to the total demand for new weapons raised by the countervailing strategy, the deployment decision of 12 December constitutes only a partial, small-scale response. While taking the new missiles into account, the strategic planners might, furthermore, not want to rely very much on them—for any single mission—since there are alternative, non-strategic uses for the same weapons as well.

VI. Divergent interests across the Atlantic: European concerns

In 1977 Chancellor Schmidt called attention to the implications for alliance strategy of the combination of parity in intercontinental systems and disparities in the European region [33]. After the agreement to modernize had been reached at Guadeloupe, the HLG suggested that somewhere between 200 and 600 missiles should be deployed: fewer than 200 would be of too little concern to the Soviet Union, while more than 600 was found too threatening (to the Soviet Union) by many participants in the Group. The 108/464 mix was finally picked by the United States, and formally adopted by the NPG meeting in November 1979 [34]. The

[15] "Potential Pershing II targets include: hardened and soft missile sites; airfields; naval bases; nuclear, biological and chemical storage sites; command and control centers; headquarters; rail yards; road networks/choke points; ammunition and petroleum storage facilities; troop concentrations and facilities; and dam/locks. Pershing II is particularly effective against hard point and underground targets . . ." [32].

West German government demanded that the final NATO decision be unanimous, and that at least one other continental European non-nuclear weapon country also accept the stationing of new missiles (the principle of non-singularity). Being particularly sensitive to political blame, it wanted the new missiles in FR Germany to be under complete US control. Italy, on the other hand, has shown interest in a two-key system similar to the one that existed for the Jupiter missiles 20 years ago [35].

The other track of NATO's 12 December decision—the invitation to negotiate, with the 572 missiles providing bargaining leverage—was promoted mainly by West European countries, particularly by some of the smaller ones. While important European government segments still associate themselves with the original rationale for modernization, the priorities differed on the two sides of the Atlantic—and increasingly so with the advent of the new US Administration. West European countries are fundamentally interested in coming to grips with the Soviet LRTNF threat, and public opinion against the deployment of cruise and Pershing missiles is very strong [22a]. The United States, on the other hand, seems much more bent on deploying the new missiles.

Once more, weapons that were in large measure justified as bargaining chips may therefore prove difficult to get rid of, although the original military-strategic rationale for deploying them has been increasingly questioned since the 12 December decision was taken. In some ways, the new missiles clearly make a difficult situation even worse for Western Europe; they burden the host countries with a number of high-priority nuclear weapon targets, and they will draw Western Europe into any strategic war between the two great powers. Even today, it is very likely that West European countries will be involved in such a war. With the new missiles on their soil, that likelihood approaches certainty. Equally important but often neglected in the public debate, the East European countries will also have to pay. In a European battle, they are likely to be the nuclear victims of the cruise and Pershing missiles, while the West Europeans face destruction from the SS-20s.

The modernization programme was an effort to give more credibility to the nuclear umbrella, or at least maintain ambiguity in relation to questions of nuclear strategy, glossing over diverging national interests across the Atlantic. To make the US commitment more visible and thereby convincing, deployment in a land-based mode was preferred. Far from reassuring the Europeans, however, that visibility made strong public opposition even more powerful than it would have been had the missiles been deployed at sea or in another, less transparent mode.

In addition, there is the fear that ever more effective war-fighting weapons may be introduced in a major-power competition which is not of European making, but which may make Europeans the main losers.

In the East, the Soviet SS-20 programme goes on: by mid-1981, the United States reported that sites had been prepared for an additional 65 launchers [36]. While the SS-20 currently has a CEP of 400 metres, it may approach 200 metres after perfection of the inertial guidance techniques. Should arms limitation efforts not succeed, a new, lighter, more mobile and terminally guided Soviet LRTN missile may, furthermore, appear towards the end of this decade. In the West, the range of the Pershing can be extended even farther, and it is claimed that the technological basis exists for installing a terminal guidance system which would make it effective against mobile targets as well—such as SS-20s on the move [37]. Greater numbers have also been considered.[16] However, for the time being, all proposals to exceed the quantitative and qualitative levels that were defined in 1979 are in abeyance: repeating them would only make it more difficult for the European governments to stand by the 12 December decision. As for cruise missiles, ALCM and SLCM programmes should, moreover, obviate whatever interest remains for more GLCMs.

For the first time in 20 years, there is today strong public opinion in Europe asking for the reduction or elimination of nuclear weapons from the continent. Discussions and public manifestations seem more intense and wide-ranging than they have since nuclear weapons came to Europe. The outcome of this debate—which has been called 'a battle for the soul of Europe'—may significantly affect the political orientation of West European countries and the shape of their defence. While the USA certainly believes that the Soviet Union poses the greatest threat to its security, many West Europeans see the US–Soviet conflict as the primary threat to them.

VII. Approaches to arms limitation

Initial positions

In April 1979 NATO established a Special Group (later the Special Consultative Group, SCG) to study the arms control implications of the emerging modernization decision. The Group took as its starting-point the need for NATO to deploy new systems—the work of the HLG being the basic frame of reference—and that arms control negotiations should be complementary to rather than a substitute for modernization. The Group also agreed that the negotiations should be conducted within

[16] In the beginning of 1979, a US Defense Nuclear Agency study came up with military requirements for 1 500 warheads. This was quickly discarded as politically unfeasible. During 1980, proposals for more than 572 missiles were aired once more [38].

the framework of SALT III, and that the USA should seek equality in ceilings and rights, even if the West did not intend to exercise such rights. To begin with, the principal negotiating objective would be to reduce the deployment of SS-20s, and to ensure the complete retirement of SS-4 and SS-5 missiles. The Western system negotiable at this stage would be the Pershing IIs and GLCMs. These land-based missile systems were to be subject to global limitations as well as regional subceilings.[17]

On 6 October 1979, the Soviet Union offered to negotiate on the condition that NATO would defer its ensuing decision to deploy new missiles. NATO rejected the offer, and the Soviet Union later declared that NATO's 12 December decision had destroyed any possibility for negotiations. That possibility received another setback when the Soviet Union intervened in Afghanistan. In response, President Carter asked the Senate to suspend consideration of the SALT II Treaty, bringing US–Soviet arms control negotiations to a full halt. The deadlock was broken by Chancellor Schmidt's visit to Moscow on 30 June–1 July 1980, when President Brezhnev declared that the Soviet Union was ready to negotiate even before the US ratification of SALT II, but that any resulting agreement could take effect only after US ratification. Furthermore, the missile question had to be discussed "simultaneously and in organic connection with the question of American forward-based nuclear means" [39].

In August 1980, Brezhnev sent a letter to President Carter and other Western leaders denouncing US reluctance to begin LRTNF negotiations. A month later, Secretary of State Muskie announced that the United States and the Soviet Union would open talks in Geneva. However, the first, preliminary round, which started on 16 October, quickly led nowhere, with sharp disagreement over which systems to include in the negotiations.

The United States presented the NATO position as agreed by the Special Group, emphasizing that the negotiations should be a step-by-step process, beginning with narrow and selective areas (i.e., land-based missiles) on the grounds that a comprehensive approach would raise a number of difficulties and complexities, minimizing the chance of progress. Therefore, the somewhat less urgent aircraft issues were to be considered at a later stage. The United States proposed that the counting unit should be warheads on launchers.

The Soviet Union held the view that if all LRTNFs are taken into account, a balance exists in Europe. A broad range of NATO nuclear capabilities were mentioned as suitable for use against targets on Soviet territory, and relevant to the overall balance. The Soviet negotiators

[17] Attempts to limit the Backfire bomber should be made in the context of SALT.

stressed the desirability of freezing the balance at existing levels, and proposed launchers as counting units.

In his speech to the 23rd Party Congress in February 1981, President Brezhnev proposed a moratorium on the deployment of LRTNFs. The moratorium would enter into force the moment negotiations began on the subject, and would operate until a permanent treaty was concluded. Both sides were expected to stop all preparations for the deployment of additional weapons. It was later indicated that the proposal did not require a halt in the production of missiles, since missile production could not be verified. Thus, US production of Pershing IIs and GLCMs might continue, while preparation of sites in Europe would presumably have to be stopped [40]. The proposal was rejected by the West as it would freeze a situation which was seen to be grossly unfavourable to NATO, and for fear that it would leave SS-20s east of the Urals untouched.

The policy of the new Reagan Administration towards the Soviet Union in general, and arms control in particular, suggested to many Europeans that the United States would not be serious about nuclear arms reductions. The Administration announced that it would undertake a comprehensive strategic review, and develop its arms control approach from there. Noting the general pre-conditions that were elaborated—negotiating leverage through arms programmes of unprecedented magnitude, linkage and new verification requirements—European worries persisted.

While both powers have stated that they will refrain from acting contrary to the provisions of SALT II until further notice, the United States made it clear that it would demand very substantial amendments. Provided that no major change occurs in the international environment, the US Administration has indicated that it will be prepared to resume the strategic arms reduction talks (START, an acronym introduced by the USA) in 1982. However, the future of these talks—of fundamental importance for LRTNF negotiations—seems highly uncertain.

To some extent, initial concerns over US intentions were ameliorated by the announcement at NATO's ministerial meeting on 4–5 May 1981 that the United States would "begin negotiations with the Soviet Union on TNF arms control within the SALT framework by the end of the year". Meeting at the United Nations on 24 September, Foreign Ministers Haig and Gromyko agreed to open negotiations in Geneva on 30 November 1981.

Overtures to Geneva

During November 1981, both the United States and the Soviet Union made far-reaching proposals for the reduction of nuclear arms which were very much addressed to public opinion in Europe. The anti-nuclear movement has become a major factor affecting the course of negotiations, so both sides evidently felt the need to please public opinion and to show that nuclear disarmament is a high-priority item on their foreign policy agenda.

In his speech at the National Press Club on 18 November 1981, President Reagan said that "the United States is prepared to cancel its deployment of Pershing II and ground launched cruise missiles if the Soviets will dismantle their SS-20, SS-4 and SS-5 missiles". This 'zero-option' proposal implied that *all* Soviet missiles of these types must be dismantled regardless of their location, including those deployed in Eastern Siberia.

In an address in Bonn on 24 November, President Brezhnev took the Soviet moratorium proposal a step further. Given agreement on a moratorium, the Soviet Union would not only be ready to halt the deployment of SS-20s, but would also be ready unilaterally to reduce the number of missiles in the European part of the USSR—"in other words engage in some anticipatory reductions moving to that lower level which could be agreed upon by the Soviet Union and the United States as a result of the talks". As part of an agreement, the Soviet Union would be prepared to make "reductions not of dozens, but of hundreds of individual weapons of this class". Brezhnev added that the Soviet Union was in favour of Europe finally becoming free of all nuclear weapons—of "all kinds of medium-range nuclear systems directed towards Europe . . . as well as of tactical weapons. That would be a real 'zero option' ".

Thus, under the influence of public opinion, both sides have adopted a declaratory policy which raises both the priority of arms negotiations and the ambition of achieving substantial reductions. Still, odds seem to be against a rapid turn of events: the general state of East–West relations and the domestic interests that influence negotiating positions are not conducive to radical departures.

Main issues

The SALT connection. The parties agree that the negotiations must be connected with a new round of negotiations on intercontinental strategic systems (often referred to as 'central systems').

The reduction of LRTNFs will certainly lose much of its significance if intercontinental systems are allowed to increase unchecked. Intercontinental weapons can be used over shorter distances as well, so if there is vastly more than enough for strategic deterrence, there is enough for regional assignments, too. SALT-accountable forces have been targeted on Europe in the past—some of them still are—and technically there is nothing to prevent this from happening on an even larger scale in the future. All the targets that can be struck by new Soviet and US theatre systems can be, or are, targeted by central systems as well.

Thus, while the renunciation of GLCMs would be a great relief for many Europeans, seen in the larger strategic context it would be of little significance if ALCMs and SLCMs are left unrestrained. In the short term, the wide dispersal of thousands of cruise missiles may appear very attractive to the United States. Any ship or submarine in the Atlantic, Pacific or Indian Ocean that may carry cruise missiles would be a potential threat to targets in the Soviet Union or to its allies. In the longer term, however, limitations on SLCMs are likely to be in the interest of the United States as well, since the Soviet Union may catch up and threaten US territory from the long Atlantic and Pacific shores. In this regard, the potential negative feed-back of an ambitious SLCM programme has been compared with the long-term consequences of the decision to MIRV intercontinental missiles. Much the same goes for ALCMs.

Another reason for linking LRTNF negotiations to SALT is that for obvious geographical reasons, global and regional parity between the two major powers cannot exist at the same time. LRTNFs in Western Europe or elsewhere on the Eurasian periphery can reach the Soviet Union, while the MIRVed SS-20s and other Soviet weapons in this category cannot reach the United States. The only regional level which is compatible with overall parity in strategic systems is defined by the figure zero. A zero solution making the deployment of cruise and Pershing missiles in Western Europe superfluous is therefore important not only for the security of European states, but also in the wider sense of facilitating US–Soviet strategic arms limitation efforts in the future.[18]

Experience suggests that negotiations which stop after agreement on some particular category of weapon has been reached in the long run prove futile, because the parties might begin to expand other forces not covered by the partial agreement. It is therefore important to see the LRTNF negotiations as the beginning of a long process which would soon overlap with strategic arms negotiations, and also lead on to systems of shorter range, that is, expand both up and down the ladder. Seven years of SALT negotiations have also shown that agreements must be more quickly negotiated than in the past.

[18] It should be noted that the strategic parity problem is particularly sensitive in relation to US LRTNFs, both because of the qualitative characteristics of the new missiles and because French and British missiles would not necessarily be fired in a direct exchange between the two major powers. The likelihood of staying outside a nuclear war between the two major powers may be very small, but in some scenarios, French and even British authorities may withhold the weapons in an effort to keep their countries out of the warfare.

Geographical domain

Press reports have indicated that the US Administration has dropped the idea of a European regional subceiling, focusing on global limitations instead. However, the only joint Western position that had been declared by the end of 1981 was that limitations should apply both world-wide and at the regional level.

The United States calls the Geneva talks "Intermediate Nuclear Force Negotiations", while the Soviet Union calls them "Talks on the Reduction of Nuclear Arms in Europe". The titles are indicative of a difference in geographical emphasis, the Soviet focus clearly being in Europe. The precise ramifications of this regional emphasis, for instance in relation to SS-20s deployed behind the Urals but within striking range of Europe, appear open to negotiation. Nor is it known whether, or under what conditions, the Soviet Union might eventually be willing to contemplate global ceilings.

In NATO deliberations, the inclusion of SS-20s on the Asian side of the Urals has been more of a European than a US demand. A case for taking even missiles deployed close to the Chinese border into account can be construed on the grounds that the SS-20 is mobile, and that with a single warhead targets in NATO Europe may be within reach. However, the missiles in the Far East are in all likelihood aimed at China, Japan and targets on other Asian territories, so to bring them into the European calculations is far-fetched.

While asking for the elimination of all Soviet LRTN missiles, President Reagan's zero proposal leaves the British, French and Chinese forces aside. This is rather extreme, because it seems to suggest that the Soviet Union has no regional security requirements in relation to the other three nuclear powers on the Eurasian continent.

The scope

While the initial US emphasis will be on the missiles covered by the zero proposal, the Reagan Administration reserves the right to seek limitations on Soviet SS-22 and SS-23 missiles to avoid circumvention of an LRTNF agreement. If deployed in sufficient numbers and moved forward on WTO territory, it is claimed that the SS-22 can cover about 85 per cent of the NATO targets assigned to SS-20s, and the SS-23 as many as 50 per cent [41]. Real negotiations on systems with a range below 1 000 km which, on the Western side, would have to comprise Pershing IA missiles may, however, be deferred to a later stage. Similarly, the West may still want to defer the aircraft issue until agreement has been reached on land-based missiles, although the position on aircraft appeared open to debate when the talks recessed on 17 December 1981.

The Soviet Union maintains that, overall, an approximate balance exists in the European theatre, with each side having an advantage in certain categories. It will almost certainly argue that any reduction should preserve the balance of forces that currently exists, and that the negotiating approach must therefore be a comprehensive one. Thus, by renunciation of all LRTNFs directed at Europe, the Soviet Union understands the renunciation of LRTN aircraft as well as British and French missile forces in this category. Included are US forward-based F-111s and F-4s, carrier-based A-6s and A-7s within striking range of Europe, and FB-111s based in the USA but intended for use in Europe.

The SS-20s deployed near the Urals are in a swing position between Europe and China, and some of them are likely to be targeted on the Middle East as well. However, they are all capable of hitting Western Europe, so by the criterion of striking range, they may all be included in the European calculations. Any partial inclusion of SS-20s in this area would, furthermore, seem arbitrary (and impossible to verify). On the Western side, some account has to be taken of British and French missiles in addition to the GLCMs and Pershings. The fact that France and the UK are not willing to take part in the negotiations is not decisive in this connection. Their forces can nevertheless be taken into consideration by allowing Soviet forces to vary correspondingly [5]. French and British missiles are, after all, directed at the Soviet Union, so for the negotiations to reflect military realities, some allowance has to be made for these forces even if they are not formally counted in the final balance.

SALT-accountable forces assigned to European missions—SS-11s, SS-19s, Yankee-class submarines which can use their missiles against Europe while in transit to and from stations near the east coast of the United States or from the Barents Sea, and the 400 Poseidon warheads assigned to SACEUR—need not enter the LRTNF calculations. Soviet SS-N-5 missiles on board Golf II-class submarines are not covered by SALT, and are treated by both sides as LRTNFs.

It is important that the terms of the negotiations be as simple as possible. With a degree of complexity similar to the Vienna M(B)FR negotiations (on mutual (balanced) force reductions), the negotiations are likely to be drawn out and inconclusive and, in effect, counter-productive. To begin with, a strong case can therefore be made for addressing the most urgent problems, namely the build-up of missiles, and leaving more complex issues such as LRTN aircraft aside. There is nothing inherently wrong with partial limitations, provided that they curb or reduce real threats and that they are not circumvented.

Also, for the Soviet Union, three factors would actually advise against the inclusion of bombers in the first phase of the negotiations. First, the complexity of the issue: the combat radius of aircraft depends on flight profile, speed, evasion of enemy air defences, payload, in-flight refuelling possibilities and availability of airfields, and these are seldom fixed quantities. Therefore, the inclusion of aircraft may well run counter to the strong Soviet interest in negotiating the non-deployment of cruise and Pershing missiles before the end of 1983. Second, the number of primary LRTN aircraft seems significantly higher on the Soviet side, both world-wide and for the European region. Third, improvements in Soviet air defence systems have reduced the penetrability of ageing Western air-craft, which for this and other reasons have become somewhat less of a threat over the past 15 years.

Generally, the Soviet Union nevertheless seems to prefer a comprehensive approach. This is a logical consequence of the view that an approximate balance currently exists in the European region. Equally important, a comprehensive approach makes sense because of perceived US efforts to gain some kind of military superiority. Superiority is not compatible with arms limitation agreements across the board, but only with partial agreements in areas not designated for achievement of upper edges. As that is the perceived context, the Soviet Union is likely to turn a sceptical eye on US proposals for narrow deals. Finally, the removal of US forward-based systems from Western Europe has been an important Soviet foreign policy objective for a long time, and still is.

However, this is not to say that the Soviet Union will necessarily insist on including LRTN aircraft in the first phase of the negotiations. A compromise might be struck between the quest for a comprehensive negotiation and for expeditious treatment of urgent missile issues, leading to a staged but integral process where the aircraft sector is brought in at a later phase.[19] For the United States, it is difficult to see how it could insist on broadening the scope of the negotiations to include SS-22s and SS-23s while continuing to deny the inclusion of forward-based aircraft.

Unit of account

While the Carter Administration had proposed warheads on launchers, the Reagan Administration proposed warheads on missiles as units of account, including reload missiles as well as those on launchers. The Soviet Union proposed launchers, in conformity with previous SALT practice.

Basically, there are three possibilities: to count launchers, missiles or warheads. There are arguments for all of them. Launchers are easiest to verify. Missiles make sense because there are four missiles per GLCM

[19] Soviet agreement to such an approach was indicated by Chancellor Schmidt in a speech before the *Bundestag* on 3 December 1981.

launcher, and reload and refire possibilities for ballistic missile launchers. However, missiles are hard to verify, and to date, none of the parties has shown much interest in making missiles the primary counting unit. In a way, warheads would be the best units of account because it is the warhead that kills, not the launcher or the missile. Warheads are much emphasized in the West because the SS-20 has been tested in a MIRV mode, while cruise and Pershing missiles carry single warheads only. However, if French and British forces are included, MIRVing of SLBMs may make warhead counting a dubious proposition for the West.

The US position therefore seems to be a maximalist stand premised on the exclusion of French and British forces. The verification of warheads on missiles is an extremely ambitious proposition, and the possibilities for verification are an unavoidable factor in the choice of counting unit. From that point of view, launchers would undoubtedly be the preferred alternative.

Numbers

President Reagan's 'zero option' was designated to be the US negotiating objective, and the US delegation reportedly had no fall-back position for the first round of the negotiations [41]. The even more encompassing zero option mentioned by the Soviet Union seemed to be a public relations counter to the Reagan proposal rather than a concrete negotiating objective: for instance, while British and French forces may be taken into account, their size cannot be determined by the two major powers, even less negotiated away. The main Soviet objective is undoubtedly to avoid the deployment of new US missiles in Western Europe.

In addition to its non-consideration of Soviet regional security requirements, the seriousness of Reagan's proposal can also be questioned on the ground that it is inconsistent with the original NATO rationale for the modernization decision. That decision was allegedly based on the judgement that new systems were required to sustain the doctrine of flexible response and enhance the credibility of the US nuclear umbrella over Western Europe. NATO had to modernize primarily because of its own force requirements, while the logic of the zero option suggests that the need to modernize would disappear with the SS-20s. The contradiction is obvious, but the problem is mainly for West European governments to sort out: following from the doctrine assessment made in the previous section, no technological fix can re-establish the coupling to US intercontinental forces that once existed, and the United States pursues the modernization programme for other reasons.

The prominence which the Reagan proposal gives to the figure zero may be taken as a concession to public opinion in Europe, because it holds out the possibility of avoiding the deployment of GLCMs and Pershings. Negotiating positions which are unrealistic in relation to this demand are likely to generate more public opposition than support. On the other hand, it can also be seen as a political tactic for making the Soviet Union responsible for new deployments: unless the Soviet Union does away with its SS-20s, NATO has to move ahead.

The threat assessment and functional requirements studies initiated by the Reagan Administration through the HLG can be interpreted in the latter direction. The threat assessment study emphasized both the speed and scope of Soviet TNF modernization, and the functional equipment study reconfirmed the need for both GLCMs and Pershings. For West European governments, 572 remains a definite high end of the modernization effort. The United States may, however, use the size of the Soviet TNF programme to support the view that 572 is at the low end of NATO requirements. This can, in turn, influence the number of NATO LRTNFs that it is willing to negotiate and that European governments would, in the end, go along with [24].

The Soviet offer to engage in some "anticipatory (missile) reductions" was a move in the right direction. International negotiations would have a better chance of success if accompanied by unilateral steps down instead of up. Apart from presupposing agreement on a moratorium, however, the offer must be seen against the background of existing Soviet predominance in missile systems, and the growing obsolescence of remaining SS-4s and SS-5s. When these missiles were deployed 20 years ago, they compensated for a clearly inferior position in intercontinental systems: this particular justification for Soviet LRTNFs no longer exists. The peoples of Europe are therefore entitled to expect substantial Soviet reductions in return for a cancellation of the Western modernization plan.

NATO's 12 December decision asked the United States to seek *de jure* equality in rights and ceilings. The Special Group had recommended it, but on the understanding that the West did not have to exercise such rights; the rationale for the modernization plan as developed by the HLG did not presuppose equality. However, the politics, psychology and experience of arms control strongly indicate that once this principle is established and a certain level agreed upon, no party will be satisfied with staying far below that limit.

Verification

The US Administration does not consider national technical means of verification to be adequate for an LRTNF agreement. More information has to be elicited from the Soviet Union: a radical improvement in Soviet willingness to provide data for the verification of future agreements is required. The Soviet Union emphasizes that national means have proved satisfactory in the past, that the effectiveness of these means is continually being improved, and that they should therefore have priority also in the future. However, also in the Soviet view, other forms of verification can be developed "if mutual trust is achieved" [42].

The introduction of cruise missiles makes it very hard to verify nuclear force deployments. There are different opinions on the verifiability of GLCMs, but less so regarding SLCMs: should the current plans for the wide dispersal of SLCMs be implemented, effective verification may well become impossible. Proliferating cruise missiles in an international atmosphere of deep distrust therefore raises unprecedented demands for ingenuity in the field of verification techniques. Substantial limitations on this technology, on SLCMs in particular, may therefore be of fundamental significance for the future of arms control.

Finally, it should be noted that zero-level agreements, prohibiting certain categories of weapons altogether, are by far the easiest to verify. The parties would then be expected to close down the factories; training for the weapons would not be justified; and there would be no weapon flight-tests. From a verification point of view, the difference between zero and one is salient, and that may go for cruise missiles more than for any other weapon.

In the autumn of 1981, the Soviet Union for the first time published figures and other information on its LRTNFs. This is a most welcome development. However, traditional Soviet secretiveness will not be abandoned overnight, and the United States seems to press for verification procedures that the Soviet Union is unlikely to accept.

Linkage

The United States takes the general view that there can be no arms control agreement without linkage. According to Secretary Haig, "we have learned that Soviet–American agreements, even in strategic arms control, will not survive Soviet threats to the overall military balance or Soviet encroachment upon our strategic interests in critical regions of the world. Linkage is not a theory: it is a fact of life that we overlook at our peril" [43]. Thus, Soviet concessions in places like Kampuchea and Afghanistan have been mentioned as pre-conditions for agreements on arms limitation. The West European allies are less prone to pursue linkage politics, especially in relation to the Geneva negotiations, where domestic stakes in a successful outcome run so high.

Linkage tends to enhance the prevailing trends in international affairs: in the first half of the 1970s, linkage politics was a deliberate strategy for the promotion of East–West co-operation and detente, whereas in recent years it has made tense US–Soviet relations even more intractable. Today, it turns arms limitation into a reward for good behaviour in other fields: if you step down here and here, we offer you mutual arms limitation in return. This is certainly hard to accept for the adversary, and hard to justify to security-minded constituencies in Europe. In reality, arms limitation and disarmament are in the common interest, both of the great powers and of the other nations of the world. In US politics, however, linkage is deeply rooted and difficult to get round.

An alternative approach: unilateral, reciprocal action

Over the past five years, the military preparedness to produce and deploy new LRTNFs has not been matched by political readiness to seek arms limitations. To a large extent, this period also has a history of unfortunate sequences and lost opportunities.

The negotiations that began on 30 November 1981 deserve support as long as they have a fair chance of succeeding. However, more than two years have passed since the 'dual track' decision was made, and the general prospects for nuclear arms limitations are bleak.

In Geneva, the parties do not agree on what to call the negotiations, what to negotiate, or what to count. They differ on geographical coverage, and there is a public relations battle over figures and how to define the military balance. Verification has once again become a controversial issue, and cruise missile technology poses very difficult verification problems.

If the negotiations become deadlocked, readiness to pursue an alternative course of unilateral, reciprocal action therefore seems important. Reciprocity can be achieved through tacit understanding, meaning East–West consultations to co-ordinate the moves undertaken by each side. That could make unilateral action more acceptable at home, and therefore easier to decide and implement.

For this approach to be pursued, the USSR should take the lead together with some key West European countries. It might be recalled that 10 years ago, *Ostpolitik* was largely pursued by FR Germany and France, with a number of more or less sleeping partners elsewhere in Europe. This time, the elaboration of a tacit understanding for reciprocal, unilateral action also depends on the right initiatives by a proper combination of countries. Again, FR Germany is a country of critical importance. The Soviet–West German agreement to consult regularly about nuclear weapons in Europe during the course of the Geneva talks is an interesting and potentially significant development, also from the point of view of readiness for unilateral, reciprocal action.

Today, European governments are urged to find a way out of the dilemmas posed by theatre nuclear weapons. Public opinion—stronger than at any time since World War II—demands a radical departure.

It would be most unfortunate if the governments of European countries were to become preoccupied with resisting and opposing these movements. Instead, they ought to seize the opportunity to reassess where we stand, approach the fundamental dilemmas of European security with the necessary vigour to improve our predicament, and give constructive direction to public activity in this field. Until recently, European leaders did not have the necessary public support to take such action, even if the desire was there. They were forced to live with the flaws and dilemmas. Today, the situation is different.

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2. The CSCE and a European disarmament conference

The 35-nation Conference on Security and Co-operation in Europe (CSCE) met in Madrid on 11 November 1980 to review the implementation of the Helsinki Final Act. The negotiations in this forum have been devoted *inter alia* to the discussion of proposals for a European Disarmament Conference (EDC).[1] The Madrid meeting continued throughout 1981 and reconvened on 9 February 1982, after the New Year recess. By the end of 1981 the participants had still not agreed on a concluding document, which would establish a European disarmament conference.

I. Background

The idea of a European disarmament conference was much discussed internationally in the late 1970s, mainly because the failure of global disarmament efforts made regional initiatives more urgent. The talks held in Vienna between NATO and the Warsaw Treaty Organization (WTO) on troop reductions in Central Europe had been pursued since 1973, also without result. The European states which were not present at these talks—that is, France and the neutral and non-aligned European nations—emphasized the need for an all-European disarmament forum. There was also some support within NATO and the WTO for convening such a conference. The arms race in Europe was intensifying, with the prospect of further substantial additions to the stocks of conventional and nuclear weapons on both sides: something should be done to try to stop this development. The second follow-up meeting of the CSCE, which was to open in Madrid on 11 November 1980, was considered an appropriate forum for more detailed debate and for a decision on a European disarmament conference. But, since the signing of the Helsinki Final Act on 1 August 1975, the movement towards detente in Europe had been, if anything, reversed. The first follow-up meeting, held in Belgrade in 1977/78, had ended in failure.

Between Belgrade and Madrid such events as the continuing deployment of SS-20s, the decision on the future deployment of Pershing II and ground-launched cruise missiles (GLCMs) in Europe as well as the Soviet intervention in Afghanistan had further increased the tension between the

[1] See SIPRI's account of these discussions up to March 1981 in the *SIPRI Yearbook 1981*, chapter 17.

two major military blocs. Therefore, even before the meeting started, there was not much optimism about the outcome.

The first stage of the Madrid meeting coincided with the inauguration of the Reagan Administration and with increased tension in and around Poland. The harder line which the USA was taking towards the USSR, and the lengthy uncertainty surrounding the new US disarmament policy, clearly affected the tenor of the negotiations in the early months. However, the longer the meeting was permitted to drag on, the more difficult it became to bring it to an end, since no tangible positive result was in sight. None of the participating states would take the blame or responsibility for bringing about a final break-down. Consequently, the Madrid meeting, originally intended to end in the beginning of March 1981, was still in session in February 1982 (as this chapter goes to press). The faint hope seems to be that something might be achieved outside the meeting, for instance at the Geneva talks on theatre nuclear forces, which might give an impetus to the Madrid discussions and bring about some positive results.

The question of the early convening of an EDC has become the major issue at the meeting. Five delegations (from France, Poland, Romania, Sweden and Yugoslavia) have tabled proposals towards this end, with the French proposal in the main reflecting the Western position, and the Polish the Eastern.

II. The EDC proposals

Although all proposals seemed to aim at the same goal, the approaches were widely different, particularly those of the Polish and French proposals; these represented the main opposing positions and provided the frame-work for most of the ensuing debate (see appendix 2A). There were also proposals of some importance from eight neutral and non-aligned delegations for an enlargement of the confidence-building measures (CBMs) of the CSCE Final Act (see the *SIPRI Yearbook 1981*).

The Polish scheme suggested a step-by-step development from the same, existing CBMs—that is, voluntary-type—towards more complex and far-reaching measures of restraint and reduction of forces and armaments in Europe. It also assumed that any proposal within the scope of the conference and submitted by a participating state would be examined.

Western delegations rejected this all-embracing, unconditional approach, claiming that it would simply create a new arena for propagandist oratory and political declarations of intent rather than for serious negotiations. They also refused to build on the present CSCE CBMs, on the grounds that they had proved to be militarily insignificant and, in addition, had been unsatisfactorily implemented, to a great extent owing to shortcomings in the Final Act. The Western delegations were consequently also negative towards the proposals for second-generation CBMs which were submitted by the neutral and non-aligned delegations.

The neutral and non-aligned paper suggested *inter alia* that participating states should notify their major military manoeuvres and movements of troops exceeding a total of 18 000 men. One of the existing CBMs applies to manoeuvres of more than 25 000 troops. The prior notification of troop movements, as well as manoeuvres, and a lowering of the threshold to 18 000 would mean a considerable improvement (see appendix 2B).

Another new CBM suggested was to notify naval exercises in European waters involving major amphibious forces of more than 5 000 troops or 10 major amphibious vessels. Amphibious forces are typically designed for offensive purposes and surprise operations and their military significance is already recognized in the Helsinki Final Act. Prior notification of such exercises would have a considerable confidence-building effect. The term "European waters" was defined in the proposal as "the inner seas of Europe, i.e., the Baltic, the North Sea and the Black Sea, the Mediterranean and the ocean areas adjacent to the territorial waters of the European participating states".

Further, it was proposed that the potential confidence-building effect of increased openness in military matters should be recognized—particularly with regard to military expenditure.

The arguments for these improved and enlarged second-generation CBMs, on the lines of the voluntary CBMs in the Helsinki Final Act, were as follows: they would give new life to the original modest set of CBMs, which had been in force for seven years; and they could pave the way for more important decisions at a later stage. The more ambitious Western proposals for another, new type of CBM might well take years of negotiation. There was, after all, no strong pressure of public opinion in their favour—most people knew nothing at all either about existing CBMs or about any new proposals. The political atmosphere was much less favourable than it had been at the time of the Helsinki conference, when a much more modest set of proposals took some years to negotiate.

Because of the Western delegations' opposition, these important proposals were never discussed at the meeting and finally disappeared entirely from the draft concluding document which the same eight delegations tabled before the December 1981 recess.

The French proposal, like the Polish, suggested a step-by-step approach but emphasized the first stage: the adoption of a coherent system of new, not 'second generation', CBMs. Such a system was described by the delegation from the United Kingdom as "an arms control regime of openness" where regular information would be exchanged on all major military formations in Europe, from divisional level upwards; on the nature, designation and location of garrisons; and also on military movements, whether for exercises or for other reasons.

The French proposal tried to lay the ideological basis for such an ambitious project by demanding that four criteria should be agreed upon at the Madrid meeting before an EDC was convened: the new CBMs should be significant in military terms; they should be binding, not voluntary; there should be appropriate verification; and they should be applicable throughout Europe, from the Atlantic to the Urals. Depending on the results achieved at an EDC, a later CSCE follow-up meeting would examine how to continue "towards security and disarmament". Since, at the time of submitting the proposal, "disarmament" was almost a taboo word for some Western delegations (more armaments for catching up with the Soviet Union were considered the key towards redressing the European balance), there was no elaboration of the second, disarmament phase in the French proposal.

The first three criteria—military significance, binding obligations and appropriate verification—are likely to be accepted by all participating states. (What is to be understood by "appropriate" or "adequate" verification will, no doubt, remain a matter for lengthy discussion, as it has for years in other arms control contexts.) The area of application, however, has turned out to be the major controversial issue. The reason for this can be traced to the CSCE Final Act provisions for the prior notification of major military manoeuvres. There it was agreed that, whereas all other European states would notify such manoeuvres within their whole territory, for the Soviet Union (and Turkey) prior notification need be given only for manoeuvres which take place in an area within 250 kilometres of the frontiers which face other European states. This meant that about 80 per cent of the European part of the USSR was not included in the application of this measure, which had been designed as a modest first step to help prevent surprise attacks from areas near the borders of neighbouring states.

This exception from the CSCE "whole of Europe" concept had been a negotiation success for the Soviet Union, mainly because some Western states were then not particularly interested in the question. It was accepted at the time as striking a kind of geographical and strategic balance, since US and Canadian territories are not included in the area of application. But when far more important CBMs were being considered for the EDC agenda and when disarmament measures in Europe might later appear on that agenda, the area problem became much more important. The catchy French phrase "from the Atlantic to the Urals", originally coined by de Gaulle, was rejected by the Eastern states, which claimed that the Final Act area provisions had been accepted as a principle and should be valid also for other CBMs.

The long-drawn-out debate on the area of application, which is still the main stumbling-block preventing a decision about an EDC, has been going on now for over a year. In February 1981, at the Soviet Communist Party Congress, Leonid Brezhnev stated that the Soviet Union would be willing to apply CBMs to the entire European part of the USSR, provided that the Western states also extended the confidence zone accordingly.

The problem was then how to compensate for this Soviet concession "accordingly". A geographic approach would be to draw border lines or establish zones in the oceans and waters surrounding Europe, where military activities would be notified mainly along the same principles as in Europe itself. Another, functional, approach would be to select certain military activities outside the European territory, but connected with activities in Europe, for the application of any measures adopted. A third possibility—perhaps the most feasible—would be to combine geographical and functional elements.

In a neutral and non-aligned paper presented on 31 March 1981, CBMs—which had then been renamed CSBMs (confidence- and security-building measures)—were suggested to cover "the whole of Europe with the adjoining sea area and air space". This was, for different reasons, not agreeable to either the Eastern or the Western side.

In July, before the summer recess, the Western states were, however, reportedly willing to agree that the measures would be applicable to the whole continent of Europe, and also to the activities of forces operating in the adjoining sea area and airspace, insofar as these activities were an integral part of notifiable activities on the continent. This was, however, not accepted by the Eastern states.

Finally, just before the December 1981 recess, a compromise was suggested by the neutral and non-aligned states in a draft final document (see appendix 2A) in which the Western text from July was supplemented with the idea that the necessary specifications of the area to be covered would be made in the negotiations on the confidence- and security-building measures at the disarmament conference itself, in the hope that by then there would be a better international climate.

The developments in Poland since December 1981, and the consequent US sanctions against Poland and the USSR, will not have made the problems in Madrid, or at any other comparable meeting, easier. A possible break-down of the CSCE would, however, be a very severe blow to the promotion of European security and co-operation. The unilateral and multilateral adoption and careful implementation of significant confidence- and security-building measures would provide convincing evidence that the intentions of the major powers were genuinely non-offensive and peaceful, which is, after all, what both sides repeatedly claim. Building confidence also requires that states abstain at the negotiating table from magnifying trivial matters into major national security concerns. Europe at present seems to be moving towards an intensified military confrontation. A European disarmament conference is badly needed, as a first step toward checking this process, and no effort should be spared in the attempts to bring such a conference about.

Appendix 2A

Proposals for an EDC

I. Proposal submitted by the delegation of the Polish People's Republic

Excerpt

. . .

The Conference will consider and agree on confidence-building measures among the participating States, complementing the measures which are being implemented in accordance with the Final Act and such measures as may be agreed upon at the Madrid Meeting; it will also consider and agree on political and legal steps to reduce the danger of the outbreak of war in Europe and strengthen the safeguards for the security of participating States, as well as measures aimed at lowering the level and the intensity of military confrontation in Europe, including the limitation of military activity and reduction of armed forces and armaments. The Conference will examine proposals which have been or will be submitted by any of the participating States.

The Conference will consider appropriate measures and will negotiate specific arrangements, step by step, beginning with simpler measures and proceeding gradually towards more complex and far-reaching ones, bearing in mind that each stage develops out of the preceding one. The task of the first stage of the Conference will be, fundamentally, to work out and adopt confidence-building measures aimed at reducing the danger of the outbreak of war in Europe. The second stage will be devoted to reaching agreement on measures aimed at lowering the level and the intensity of military confrontation in Europe, including the limitation of military activity and reduction of armed forces and armaments, taking into account the results of the negotiations on limitation of armaments and on disarmament in other forums.

The arrangements in these areas should be without prejudice to the security of any State.

Source: Madrid Conference document CSCE/RM/6, 8 December 1980.

II. Proposal submitted by the delegation of France

Excerpt

The Conference . . . will have as its terms of reference:

—The initiation of a process whose goal it will be, initially, to adopt a coherent system of confidence-building measures applicable throughout the European continent, from the Atlantic to the Urals.

—The establishment of conditions under which these confidence-building measures, which will be of significance in military terms and binding, will be accompanied by provisions ensuring appropriate verification of the commitments entered into.

The states therefore consider that the Conference will need to examine:

A.—Information measures designed to improve knowledge of armed forces.

B.—Measures designed to increase stability, *inter alia*, by shedding light on standard military postures, in particular by indicating, in accordance with precise rules, the scale and range of specific military activities.

C.—Measures to monitor and verify observance of commitments entered into....

They therefore agreed that the next CSCE follow-up meeting, to be held at ... in ..., would examine, in the light of the results obtained, the conditions in which these goals could be pursued, having regard *inter alia* to the progress of other negotiations affecting Europe in the disarmament sphere.

...

Source: Madrid Conference document CSCE/RM/7, 9 December 1980.

III. Proposal submitted by the delegations of Austria, Cyprus, Finland, Liechtenstein, San Marino, Sweden, Switzerland and Yugoslavia

Excerpt

...

Conference on Confidence- and Security-building Measures and Disarmament in Europe.

...

Have agreed to convene a Conference on Confidence- and Security-building Measures and Disarmament in Europe, commencing in 1982/83.

1. The aim of the Conference is, as a substantial and integral part of the multilateral process initiated by the Conference on Security and Co-operation in Europe, with the participation of all the States signatories of the Final Act, to undertake, in stages, new, effective and concrete actions designed to make progress in strengthening confidence and security and in achieving disarmament.

2. Thus the Conference will begin a process of which the first stage will be devoted to the negotiation and adoption of a set of mutually complementary confidence- and security-building measures designed to reduce the risk of military confrontation in Europe....

4. ... these confidence- and security-building measures will cover the whole of Europe as well as the adjoining sea area and air space. They will be of military significance and politically binding and will be provided with adequate forms of verification which correspond to their content.

As far as the adjoining sea area and air space is concerned, these measures will be applicable to the military activities of forces of all the participating States operating there in so far as these activities constitute a part of activities in Europe which the participating States will agree to notify. Necessary specifications will be made through the negotiations on the confidence- and security-building measures at the Conference....

5. Taking into account the above-mentioned aim of the Conference, the next follow-up meeting of the participating States of the CSCE, to be held in ..., commencing on ..., will assess the progress achieved during the first stage of the Conference.

6. Taking into account the relevant provisions of the Final Act, and having reviewed the results achieved by the first stage of the Conference, and also in the light of other relevant negotiations on security and disarmament affecting Europe, a future CSCE follow-up meeting will consider ways and appropriate means for the participating

States to continue their efforts for security and disarmament in Europe, including the question of supplementing the present mandate for the next stage of the Conference on Confidence- and Security-building Measures and Disarmament in Europe.

7. A preparatory meeting, charged with establishing the agenda, time-table and other modalities for the first stage of the Conference, will be held in . . ., commencing on . . . Its duration shall not exceed three weeks.

. . .

Source: Madrid Conference document CSCE/RM/39, 16 December 1981.

Appendix 2B

Notifications of military manoeuvres in 1981, in compliance with the Final Act of the CSCE

State giving notification	Date of notification	Duration of manoeuvre	Designation of manoeuvre	Number of troops involved*	Area of manoeuvre
Norway	19 Feb	13–18 Mar	Kald Vinter 81[1]	11 000	Troms (northern Norway)
USSR	14 Aug	4–12 Sep	Zapad[2]	. .	Byelorussian and Baltic military districts and the Baltic Sea
FR Germany	21 Aug	14–23 Sep	Certain Encounter[3]	71 000	Bad Sooden/ Allendorf–Bischofsheim–St Goar–Bad Honnef
USA	24 Aug	14–23 Sep	Certain Encounter[3]	70 000	See above
FR Germany	24 Aug	14–18 Sep	Scharfe Klinge[4]	48 000	Schwäbische Alb
Canada	25 Aug	14–18 Sep	Scharfe Klinge[4]	. .	FR Germany
Denmark	28 Aug	20–25 Sep	Amber Express 81[5]	22 000	The Sjaelland group of islands
Norway	28 Aug	18–23 Sep	Barfrost 81[6]	9 000	Nordland and Troms (northern Norway)
Switzerland	9 Sep	12–22 Oct	Cresta[7]	25 000	Canton of Grisons
FR Germany	9 Sep	1–23 Oct	Red Claymore[8]	22 500	Wiedenbrück–Brakel–Holzminden–Dassel–Northeim-Osteroda–Bad Harzburg–Holle–Peine–Bad Nenndorf–Hameln–Herford
UK	10 Sep	1–23 Oct	Red Claymore[8]	22 500	See above
Belgium	18 Sep	12–24 Oct	Cross Country[9]	21 000	FR Germany: Göttingen–Kassel–Berleburg–Soest–Paderborn–Dassel
FR Germany	21 Sep	12–24 Oct	Cross Country[9]	21 000	See above
Spain	5 Oct	26 Oct–4 Nov	Crisex 81[10]	32 200	Province of Almeria

* It may be incorrect to add together the number of troops in different manoeuvres taking place within the same time period, as some troops may participate in more than one manoeuvre.

[1] 'Kald Vinter 81'—a national field manoeuvre.

Purpose of the manoeuvre: Routine field exercise of Brigade North and other units under winter conditions, in co-operation with allied units and naval and air defence units. Command level: Commander, North Norway.

Participating units: Brigade North and minor ground units (Norway); 36th Marine Amphibious Unit, Marine Corps (USA); 3rd Commando Brigade Royal Marines (UK), including one Amphibious Combat Group from the Netherlands marine infantry (Royal Netherlands Marine Commando); one company from the Canadian air–sea Transportable Combat Brigade; in addition, Norwegian air defence units, allied air forces and Norwegian and allied naval forces.

[2] 'Zapad'—a ground and naval forces manoeuvre.

Purpose of the manoeuvre: to improve co-ordination and co-operation between units from different branches.

Participating forces: Operative staffs and units from different branches of the USSR armed forces.

Designation of the manoeuvre and numerical strength of participating forces not supplied in the notification.

[3] 'Certain Encounter'—a multilateral manoeuvre with opposing forces supported by air force units in the context of the Autumn Forge field training and command post exercises being conducted by members of NATO. It includes US troops being transported to Europe in the 'Reforger 81' movement.

Purpose of the manoeuvre: to train allied troops in combat arms operations and to exercise co-operation between major NATO units. Command level: Headquarters 5th US Corps.

Participating units: 3rd Armoured Division, 4th Infantry Division, 8th Infantry Division (USA); 20th Armoured Brigade (UK); 5th Armoured Division (FRG). Air support supplied by air force units of the participating states.

Absence from garrisons: 9–25 September.

Foreign observers invited to attend.

[4] 'Scharfe Klinge'—a manoeuvre with opposing forces supported by air force units.

Purpose of the manoeuvre: to train FRG forces in combat operations and to train co-operation between major NATO units. Command level: Headquarters 2nd Corps (FRG).

Participating units: 2nd Corps and Territorial Commando South (FRG); one brigade (USA); 4th Mechanized Brigade Group (Canada). Air support supplied by air force units of the participating states.

Absence from garrisons: FRG troops, 10–20 September; Canadian troops, 4–20 September.

Foreign observers invited to attend.

[5] 'Amber Express 81'—a joint ACE (Allied Command Europe) Mobile Force (AMF) field training manoeuvre with naval and air support.

Purpose of the manoeuvre: to exercise and train the ACE Mobile Force northern component in its deterrent and defensive combat roles alongside host nation forces according to contingency plans, to demonstrate NATO solidarity, and to exercise and train UK mobile forces. Command level: Commander allied forces Baltic approaches (Combaltap).

The manoeuvre is part of a multinational exercise conducted in Denmark during 5 September–3 October. On 19 September a live-firing demonstration, 'Amber Barbara 81', takes place.

Participating units: Corps troops, two armoured infantry brigades, territorial forces (Denmark); AMF northern component; contingents from Belgium, FRG, Italy, Luxembourg, the Netherlands, UK (units from mobile forces and one marine commando group) and USA.

Absence from garrisons: AMF and UK troops, 12 September–3 October.

Foreign observers invited to attend.

[6] 'Barfrost 81'—a national field manoeuvre with the participation of Canadian forces.

Purpose of the manoeuvre: routine exercise of Brigade North and the combined regiment in different operations, including co-operation with naval and air defence. Command level: Commander, North Norway.

Participating units: Brigade North and minor national ground units, Combined Regiment 14; one Canadian rifle company; Norwegian air and naval forces and allied air forces.

[7] 'Cresta'—a national field manoeuvre.

Purpose of the manoeuvre: to control the level of instruction and training of Swiss troops in the following branches: war mobilization, protection of neutrality and deployment under difficult conditions. Formation and control of first preparation for combat. Command level: Commander 3rd Mountain Army Corps.

Participating units: Army corps units, major part of 12th Mountain Division, one combat brigade, logistic units, parts of the air force.

Absence from garrisons: 12–31 October.

[8] 'Red Claymore'—UK division-level field training exercise in the context of the NATO 'Autumn Forge' series of exercises.

Purpose of the manoeuvre: to practice the deployment of 3rd Armoured Division reinforced by Territorial Army units from the UK, for defensive operations. Command level: Headquarters, 3rd Armoured Division.

Participating units: 3rd Armoured Division, part of Artillery Division, Territorial Army units.

Absence from garrisons: British troops stationed in FRG leave garrisons on 30 September; those in the UK on 3 October; return immediately after the field manoeuvre period.

[9] 'Cross Country'—field manoeuvre with opposing forces.

Purpose of manoeuvre: to train combined army operations and co-operation between major NATO forces. Command level: Commander 1st Belgian Corps.

Participating units: from 1st Belgian corps; one FRG armoured brigade supported by a group of anti-tank helicopters, one US helicopter unit. Air support supplied by air force units of participating states.

Absence from garrisons: 12–23 October.

[10] 'Crisex 81'—a national manoeuvre with the participation of US forces.

Purpose of the manoeuvre: to train participating units.

Participating units: from Spanish and US ground, naval and air forces.

3. The neutron bomb

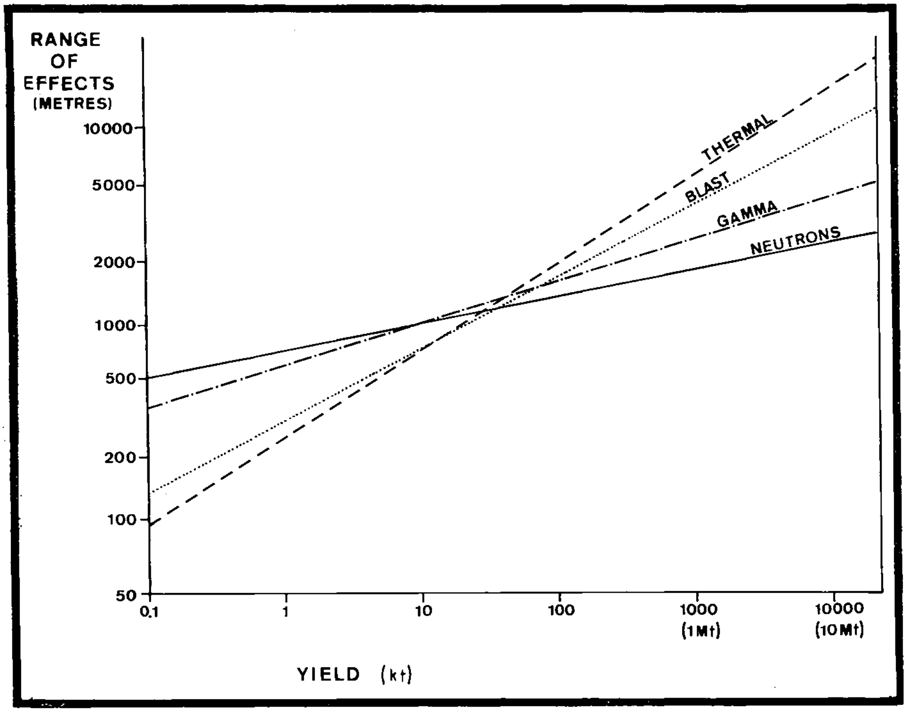
Square-bracketed numbers, thus [1], *refer to the list of references on page* 74.

I. What is a neutron bomb?

The 'neutron bomb' is the popular name given to those nuclear weapons whose predominant effect is to cause casualties from the neutrons emitted when it is exploded. Any very low-yield weapon (less than about 1 kiloton), whether its energy is derived from fission or fusion reactions, has this property. The neutron effects can, however, be enhanced if fusion reactions are used to produce the energy, since these produce large numbers of high-energy neutrons, which are not so easily absorbed by bomb materials and air. They can also be enhanced by constructing the weapon so that fewer neutrons are trapped in its outer layers. Hence in official circles 'neutron bombs' are normally referred to as enhanced radiation weapons (ERWs) because the weapons are specifically designed to produce more neutrons per unit of energy released and to allow these neutrons to escape from the surrounding bomb materials.

No matter how they are designed, high-yield weapons will never be 'neutron bombs'; conversely, for all very low-yield weapons the blast effects will be relatively unimportant compared to the neutrons. As the yield is reduced, first thermal radiation and then blast become less important in comparison with prompt gamma radiation and then neutrons. This is because the scaling laws for calculating how the range of a given effect varies with the yield are different for thermal, blast, gamma radiation and neutrons. Neutrons and gamma radiation are strongly absorbed by the air at normal atmospheric pressures so that as a consequence they do not travel long distances at low altitudes. Since neutrons are slightly more strongly absorbed than gamma rays, the range of neutron effects increases with yield even more slowly than that of gamma rays. Blast waves are only slightly attenuated as they propagate through the atmosphere, and the range for blast effects increases as the cube root of the yield. Thus in the case of higher-yield weapons they extend far beyond those from neutrons and gamma rays. Thermal radiation is not absorbed significantly in clear air and, therefore, the range increases as the square root of the yield. Thus for very high-yield explosions (megatons) in relatively clear weather, thermal radiation can predominate over blast, and prompt nuclear radiations (neutrons and gamma rays) are inconsequential; for very low-yield weapons the reverse situation exists. The cross-over yield below which

Figure 3.1. Scaling laws for weapon effects

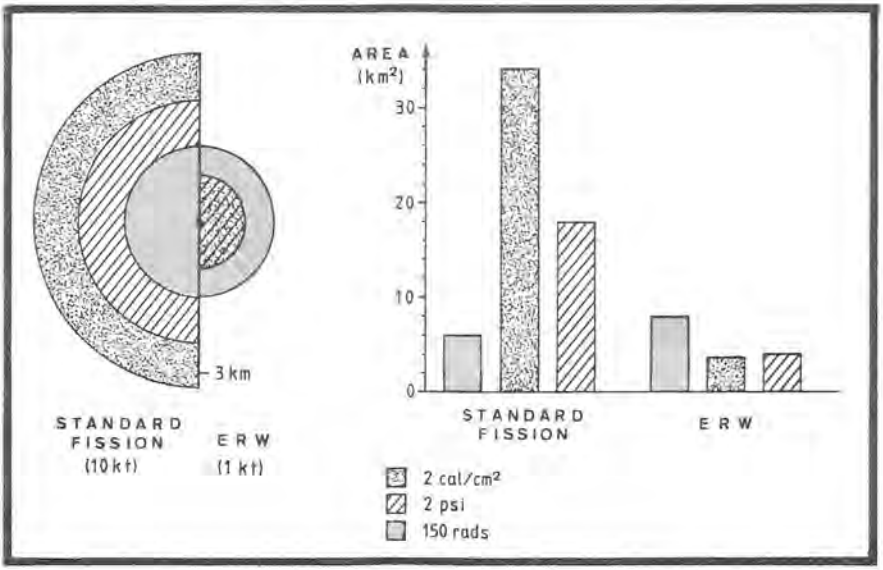


neutrons become predominant is about 1 to 10 kt. A representative diagram showing these relationships is given in figure 3.1.

By the use of enhancement techniques it is possible to design a 1-kt weapon that will have nuclear radiation effects on tank crews at about the same distance as a 10-kt standard fission weapon. Since the total yield will, however, be only one-tenth as great, the distance at which blast effects will be produced will be decreased by the cube root of 10 or slightly more than a factor of two. This neutron enhancement is obtained by having only a very low-yield fission trigger and obtaining most of the energy from fusion reactions. Furthermore, all materials which are good absorbers of high-energy neutrons are eliminated from the outer layers of weapons. In particular natural uranium, which would normally be included in a fission weapon to capture any high-energy neutrons and produce additional fission and energy, is eliminated. Thus more high-energy neutrons can escape into the atmosphere.

The partition of energy from a standard fission and an enhanced radiation warhead is shown in figure 3.2. Because the neutrons can escape more easily from the ERW materials, the fraction of energy in prompt radiation is much higher (approximately 30 per cent as compared with 5 per cent).

Figure 3.2. Typical energy partition



Since these neutrons are not absorbed directly around the bomb there is less heating and the amounts of energy that come out as blast and thermal radiation are each about 10 per cent lower. It will be noted, however, that 40 per cent of the energy is still emitted as blast so that fission weapons and ERWs with the same yield would not have very significant differences in the radii for blast damage. The lower yield of the enhanced radiation warhead, rather than its enhancement characteristics, accounts for the reduced blast damage.

II. What are the security justifications for the neutron bomb?

The ostensible military justification for the neutron bomb is to improve NATO capabilities to repel Warsaw Treaty Organization (WTO) massed tank attacks. The WTO outnumbers NATO in numbers of tanks, and a persistent fear of Western military planners has been that Soviet tank columns could break through the West German front and wreak havoc on NATO defences. NATO has very formidable anti-tank weapons, including high technology precision-guided munitions (PGMs) using non-nuclear kill mechanisms, but military planners have argued that this is not enough. As a consequence nuclear artillery shells and short-range missiles have been deployed for many years to force the USSR to disperse its tank forces. The enhanced radiation warheads are modernized versions of these, which it is hoped would render Soviet tank superiority ineffective.

One concern about existing Western nuclear warheads has been the collateral damage they would cause if they were actually used in the built-up areas of Western Europe. It was recognized that in the process of repelling Soviet tanks, NATO might end up by destroying Western Europe. These collateral effects might prevent Western leaders from ever authorizing their use. If the Soviet leaders could rely on this, then they might not be deterred from aggression with massed tank formations. The ERWs, because of the reduced blast effects of their low yields, were sought as a means to increase the credibility of the deterrent against such Soviet aggression. Making the decision to use nuclear weapons easier would thus make it less likely that they would actually be used.

III. Current status of the neutron bomb programme

In the 1960s the US Army had deployed in Europe a small bazooka-like nuclear weapon which could be handled by two men and had a yield of a few hundredths of a kiloton. Although this was a fission device with no enhancement characteristics, its primary effects would have been to kill personnel with neutrons. This was deployed without any public attention and then later withdrawn because the Army did not find it militarily useful.

In the late 1970s the United States developed enhanced radiation warheads for the Lance missile with a range of about 100 km, and for the 203-mm (8-inch) artillery howitzer with a range of 29 km. This was part of the modernization programme for NATO weapons. Consideration was also given to the development of such a warhead for the short-range, 155-mm howitzer, but this apparently ran into some technical difficulties because of the small diameter. While these are reported to have been solved, the warhead is not believed to be in the approved production programme. In 1978 President Carter approved production of the non-nuclear but not the nuclear components for the Lance and 203-mm shells. In the summer of 1981 President Reagan authorized, without consultation with his NATO allies, the procurement and stockpiling of the complete enhanced radiation warheads, but in order to mollify public opposition in Europe he announced they would not be deployed overseas at this time. If they are to be a deterrent to a Soviet tank attack, they will, however, have to be moved to Europe well in advance of a crisis. Thus the decision to deploy them in Europe cannot be avoided forever.

The old fission warhead for the Lance missile is reported to have the option of having several yields—1 kt, 10 kt and 70 kt. The 10-kt version is believed to be the optimum yield for forcing dispersal of Soviet tanks. The new enhanced radiation warhead would have a yield of about 1 kt.

The 203-mm howitzer fission warhead reportedly had yield options of 1–2 kt, and the new enhanced radiation version presumably a somewhat lower yield, reportedly 0.7 kt.

IV. The effects of nuclear weapons [1]

Nuclear radiation

The nuclear radiations—neutrons and gamma rays—do not destroy tanks, but only incapacitate the crews manning them. Their effects on people are, however, complex, and the onset of symptoms varies widely with the total dose or exposure. Neutron effects are different from gamma rays, but because there is less experimental data, they are not nearly as well known. In an actual conflict people will often be exposed to a mixture of gamma rays and both high- and low-energy neutrons, whose biological effects are different. Attempts are made to take these complications into account in military analyses, but it must be realized that there will never be a sharp line dividing the exposure which will incapacitate a soldier or injure a civilian bystander.

A person exposed to a lethal dose of approximately 450 rads, for example, would not be immediately put out of action but could become sick several hours to a day later and would die within a month. If the exposure is increased to about 2 000 rads, then the onset of symptoms will be much earlier. A person might be temporarily incapacitated almost immediately, suffering shock and perhaps even nausea, but could then temporarily recover for a period of several hours, then relapse and die a few days later. If the exposures were even higher, say 8 000 rads or over, then an individual would be put out of action almost immediately and die in a relatively short period of time [2].

The normal metals in a tank are not particularly effective in absorbing neutrons so they do not provide any significant protection to the crew. Special neutron shielding in a tank may or may not be practical. The steel in a tank would, however, reduce the exposure to gamma radiation, which becomes relatively more important compared to neutrons as the yield of the warhead increases. Taking all these factors into account the US Defense Department has used for analysis purposes an exposure of 3 000 rads as sufficient to put a tank out of action.

Much lower exposures will have significant longer-term effects. These will be of no immediate military use but must be taken into consideration in evaluating the consequences of the use of these weapons on military personnel and civilian bystanders. An exposure of 100–200 rads could produce early symptoms, particularly nausea and lowered blood counts. Exposure to 25 rads could significantly increase the risk of leukaemia several years later. Since large populations will be exposed in a war, even lower doses might cause significant numbers of people to suffer some long-term effects.

Blast effects

To prevent the tank itself from functioning, the US Defense Department has estimated that it would require a blast pressure of approximately 17 psi (lb/in^2). Under this type of exposure the tank would no longer be operable even with a healthy crew. Its treads could be damaged or the tank even be rolled over. The damage should be visible to an observer from some distance away.

Much lower pressures are required to damage buildings. For example, approximately 3 psi would be sufficient to produce significant damage to civilian structures, and there would be considerable destruction at even lower pressures. A blast pressure of 6 psi would seriously damage most civilian structures and the 17 psi needed to knock out tanks would leave few buildings standing.

V. Effectiveness of nuclear weapons against tanks

To evaluate the usefulness of the neutron bomb, the actual effects must be examined in detail. For this analysis a 1-kt ERW was selected as a typical neutron bomb, although the actual yields of the weapons deployed might range from about 0.5 to 5 kt. For comparison a 10-kt standard fission weapon has been used since this is believed to be typical of the Lance warhead that the new ERW will replace. In some situations a 1-kt standard fission weapon will be examined since this is more representative of the existing 203-mm shell.

In figure 3.3 the data on the effects of these weapons on tanks are directly compared. The old standard fission warhead for the 203-mm shell is compared in table 3.1 with the 1-kt enhanced radiation version.

From these data it will be seen that the enhanced radiation 1-kt Lance warhead will have approximately the same radiation effects on tank crews as the existing 10-kt fission warhead for that missile. The radius at which tank crews will be put immediately and permanently out of action (8 000 rads) is significantly larger for both of these warheads than the

Figure 3.3. Effectiveness of fission and enhanced radiation weapons against tanks

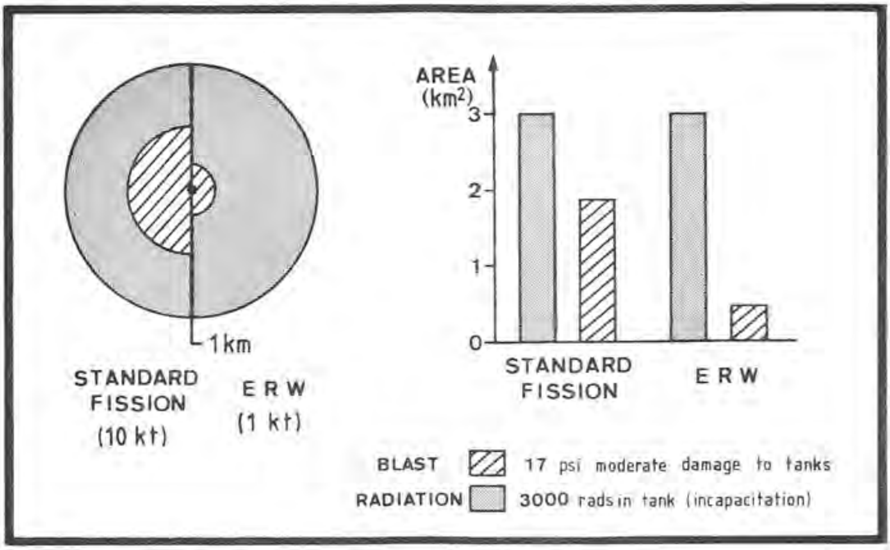


Table 3.1. Radii of weapon effects (metres)

Weapon	Burst height (metres)	Radiation dose			Blast effects		
		8 000 rads	3 000 rads	650 rads	17 psi	6 psi	3 psi
1-kt ER	150	690	820	1 100	280	430	760
1-kt fission	150	360	440	690	300	520	910
10-kt fission	150	690	820	1 100	640	910	1 520

Source: Except for 17-psi blast data, reference [3].

radius at which the tanks themselves will be damaged by blast. Thus from the point of view of radiation effects there is no difference between the new neutron warhead for the Lance and the existing fission one. The range of blast damage to tanks will be much greater for the old Lance warhead than for the new ERW (more than twice as great), and this could be militarily very significant.

In the case of the 203-mm artillery shell, which will have a 1-kt yield for both the enhanced radiation and the existing fission warheads, the ERW will incapacitate tank crews at almost twice the distance. The range of blast effects on tanks will be slightly greater for the standard fission weapon, but in both cases quite small and not sufficient to justify the use of nuclear weapons.

Kent Wisner [4] has concluded that the actual military advantage of the greater range of neutron effects of the ERW warhead in the 203-mm shell is quite limited in light of Soviet doctrine for tank attacks. This analysis shows that only when a Soviet tank battalion approaches the line of contact with enemy forces (4–6 km away) and deploys into complete columns (750–1 000 m apart) will there be significant advantage for the ERWs. At greater distances and on closer contact the expenditure of nuclear munitions will be the same regardless of the type of warhead. Thus only under limited circumstances will the enhanced radiation warhead for the 203-mm shell provide significantly greater military capability for destroying tank crews by radiation.

But even this limited advantage of the ERWs is not realistically useful for repelling tank attacks on the battlefield. Killing the tank crews is not a very satisfactory way of stopping tanks because a battlefield commander can never be sure when the enemy tank has been put out of action. Unless a very high super-lethal exposure is obtained, the tank crew might be able to continue fighting even though it was doomed eventually to die. Even if the crew had been put out of action there would be no way to be certain that this was the case by external observation. There would always be the fear that the crew would temporarily recover and be able to continue combat as a kamikaze unit. Since the tank itself would be undamaged at the distance that the crew had been killed, there would also be the possibility that new crews could take over the tank.

On the battlefield the most satisfactory way of knocking out a tank column is to destroy visibly the tank itself. This can only be done by blast from a nuclear weapon or by hitting the tank using conventional PGMs. Under these circumstances there is no question that the tank has been put out of action. Unfortunately neither the enhanced radiation nor the standard fission 1-kt warheads for the 203-mm shell will do this at significant distances. However, the existing 10-kt fission warhead for the Lance will destroy tanks to a distance of about 0.5 km. Thus if nuclear weapons were used to repel a Soviet tank attack, there is little doubt that the existing Lance warhead is superior to the ERW version [5].

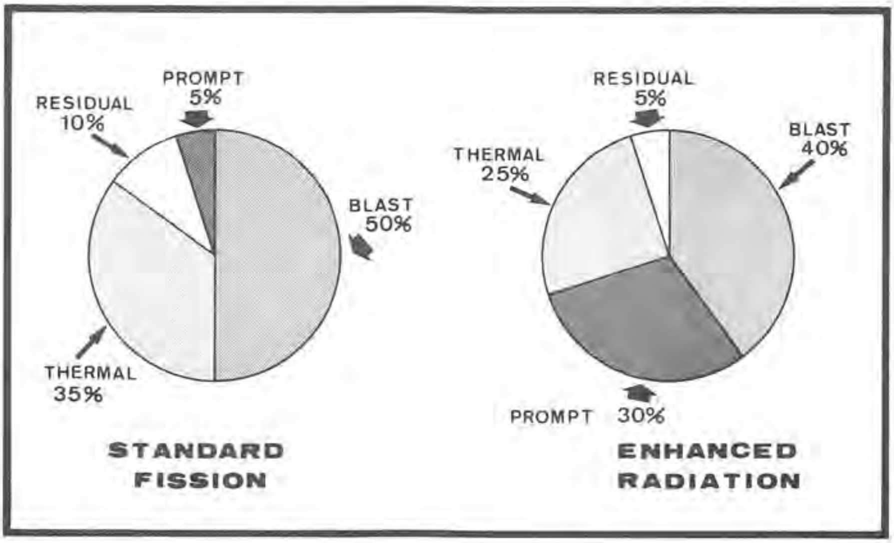
Since neither 203-mm artillery shell is particularly effective, PGMs would seem to offer a far better and less dangerous alternative. Even in the case of the Lance, serious questions can be raised as to whether the increased kill radius from blast of the nuclear alternative is superior to reliance on conventional munitions. If the threshold between conventional and nuclear weapons is to be crossed, certainly the military effectiveness of the nuclear round must be very much greater to make such escalation truly necessary.

VI. Collateral effects

Blast damage

The major differences between enhanced radiation warheads and the existing fission warheads will be in the collateral blast damage to urban structures. The ranges of these effects are summarized in table 3.1 and figure 3.4. Collateral damage will be relatively low but by no means completely absent for the 1-kt warheads for either of the 203-mm shells and for the enhanced radiation Lance warhead. Were the tanks to be attacked in a village, all the buildings within about 500 m would be severely damaged. The Hiroshima bomb had a range of blast damage less than $2\frac{1}{2}$ times that of the 1-kt warheads. For the existing 10-kt standard fission warhead, almost equivalent to the Hiroshima bomb, the blast damage can be very large, the damage radius being more than twice as great as for the 1-kt ERW. The primary argument for replacing the current Lance warhead with the lower-yield enhanced radiation version was to reduce these collateral blast effects. This reduction would make the decision for the first use of nuclear weapons easier since the field commander—and ultimately the President of the United States—would not be in the position of ordering a defence that would destroy the cities of Western Europe; but realistically these smaller weapons will not spare

Figure 3.4. Collateral effects of fission and enhanced radiation weapons



European cities. Once nuclear weapons have been used on the battlefields in Europe, whether they be enhanced radiation or fission weapons, the Soviet Union would almost certainly respond with its most effective warheads and disregard their effect on neighbouring buildings. US reliance on ERWs will not ensure the survival of European cities in the event of a nuclear war. The only way to avoid such widespread destruction would be to rely on conventional PGMs.

Radiation exposure of civilian and military bystanders

The damage to buildings is not the only criterion that will determine the acceptability of nuclear explosions in the inhabited areas of Western Europe. The radiation exposure of the population is also very important. Civilian bystanders, just like tank crews, are susceptible to becoming casualties from nuclear radiation. Friendly troops must also be spared the long-term radiation effects. Even if they survived initially, it would not be acceptable for military men to die miserably years after the conflict was over. This means that nuclear weapons cannot be used close to friendly forces, a serious drawback in a mobile, often confused battlefield situation.

A 1-kt enhanced radiation warhead would produce an exposure of 150 rads at about 1.5 km from the point of detonation (see figure 3.4). Even if people were in shelters, reducing the exposure by a factor of five, they would be liable to suffer long-term radiation effects, perhaps leukaemia, eye cataracts or genetic damage. Although the effects are not so precisely known, neutrons are more prone to produce long-term biological effects than is gamma radiation. Significant radiation casualties could be expected over an area of 10 km^2 for each enhanced radiation weapon used. Since any major conflict in Europe in which neutron weapons were used to repulse Soviet tank thrusts could involve 1 000 to 10 000 such battlefield weapons, the total area in which Europeans could be subjected to dangerous neutron exposures could range from 10 000 to 100 000 km^2. The number of actual casualties would, of course, depend upon the exact area in which the tank battles occur, but the number will almost certainly be very large. The neutron bomb is not a prescription for a safe nuclear war for Europeans.

Radioactive contamination

The deposition of radioactive materials around the battle zone or on civilian populations can be a serious problem for both ensuing military operations and the safety of civilian bystanders. Neither the standard fission weapons nor the neutron bombs will produce serious fall-out of radioactive fission products on the battlefield in the vicinity of the point of the explosion provided that the height of burst is high enough to prevent the fireball from touching the ground (about 150 m for a 10-kt explosion, or 75 m for a 1-kt explosion). Furthermore this height of burst is about the optimum for putting tanks out of action (17 psi) and is normally desirable unless hardened underground shelters are being attacked. Therefore, even if local fission product fall-out is to be avoided, there is little advantage in having a weapon deriving only a small fraction of its energy from fission. On the other hand, the neutrons from ERWs react with materials in the soil to produce induced radioactivity in a circle around 'ground zero' (the point on the ground directly beneath the point of detonation). This induced radioactivity will be greater than for fission weapons of the same yield. It would be sufficient to prevent unlimited occupation of an area of 3 km^2 around ground zero for a couple of days with an ERW of 1 kt exploded at a height of 75 m. This could be an important drawback to the use of ERWs in the event that friendly forces wish to occupy the area after the tank attack had been repulsed.

VII. Likelihood of nuclear war

No one can predict how the availability of ERWs will influence the decision to initiate the use of nuclear weapons in a European conflict. The precise nature of the conflict, the attitudes of the leaders and military commanders of the time and the perceptions of the risks at that time will all have major impacts. Proponents of these weapons make the claim that the decision to employ the nuclear wearheads will be easier in view of their reduced blast destruction in urban areas. Thus they argue that the deterrent to a Soviet tank attack will be much more credible. But if the decision to use these weapons is really easier, it should also increase the chances that a conflict will become nuclear. Proponents assert that, nevertheless, nuclear war will not be any more likely, because any President of the United States would recognize the significance of the first use of nuclear weapons and would not be influenced to make such a decision just because of the reduced blast effects. President Carter made a statement to this effect when he authorized proceeding with the programme in 1978. If the USSR recognizes this, then there is no basis for enhanced deterrence. This dichotomy between credibility of the deterrent and likelihood of use can never be resolved in advance of an actual confrontation. The risks that a nuclear war presents to our civilization certainly demand that no steps be taken that would increase the chances that nuclear weapons are actually used in any conflict.

VIII. Conclusions

The military advantages of the neutron bomb over existing nuclear weapons have been greatly exaggerated by political leaders in the West. The increased dangers they present to the peoples of Western Europe in comparison with existing nuclear warheads have been greatly exaggerated by political leaders in the East. The use of any nuclear weapons, fission or neutron bombs, would be an unparalleled disaster for Europe.

The Lance enhanced radiation warheads are probably less effective in repelling tank attacks than the fission warheads they replace, and they will reduce urban blast damage only if the Soviet Union does not retaliate with fission weapons of its own. The 203-mm ERW shells have an enhanced capability for putting tank crews out of action in limited combat situations, but have essentially the same collateral effects as the current fission versions. Neither the fission nor the ERW warheads for the 203-mm shell are particularly effective in destroying tanks themselves and do not warrant their first use in place of PGMs.

Crossing the threshold from the use of conventional weapons to the first use of any nuclear weapons will create an extremely high risk of escalation to all-out nuclear war. The contribution of the deployment of neutron bombs in Europe to the deterrence of Soviet aggression would appear marginal, and it could make it easier to cross this threshold and thus make the devastation in Europe and probably the world more likely.

The neutron bomb is the wrong approach to the modernization of nuclear weapons in Europe. The aim should be to reduce, not increase, the likelihood of their use. They serve only as the ultimate deterrent to Soviet aggression, for if they are ever used they will have failed in their purpose. The West must move to decrease reliance on any nuclear weapons to meet military requirements and move to a position where Western conventional weapons can deter any conventional attack from the East.

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4. Nordic initiatives for a nuclear weapon-free zone in Europe

Square-bracketed numbers, thus [1], *refer to the list of references on page* 93.

I. Introduction

In 1961 Swedish Foreign Minister Undén suggested the creation of a 'club' of states obligated not to acquire nuclear weapons and not to accept deployment of nuclear weapons on their territories. In 1963 President Kekkonen of Finland adapted and confined Undén's idea to the Nordic region, proposing a Nordic nuclear weapon-free zone (NWFZ).[1]

The overriding concern behind the Kekkonen proposal was to keep the Nordic countries out of "the realm of speculation brought about by the development of nuclear strategy", and to maintain a state of low tension in the area. That same concern prompted a revised version of the proposal in 1978 [1], and has been an important impetus for the recent surge of interest in the zone issue in all the Nordic countries, precipitated by a programme declaration of the governing Labour Party in Norway.[2]

In the following sections, the main issues and problems connected with the creation of a Nordic NWFZ are discussed under 10 subject-headings.

II. Objectives

The overall objective of the Nordic NWFZ proposals is to strengthen the security of the countries in the region, and to stabilize relations between the big powers in this strategically important area.

The constellation of ground forces in northern Europe has remained stable for a number of years. Both Eastern and Western countries have shown restraint. However, military capabilities at sea and in the air are rapidly increasing in the region, threatening the security interests of all parties—Eastern, Western and neutral.

[1] In a letter to the Prime Minister of Norway of 8 January 1958, Soviet Prime Minister Bulganin mentioned the possibility of making northern Europe a zone free of nuclear weapons. In 1959, Prime Minister Khrushchev proposed a NWFZ in the Baltic area. The Polish disengagement proposals concerning Central Europe were more important for later Nordic initiatives; the Rapacki plan of 1957 was the first fully elaborated NWFZ proposal to be presented to the United Nations.

[2] The platform adopted by the Party Convention on 2–5 April 1981 reads: "The Labour Party will work for a nuclear weapon-free zone in the Nordic area as an element in the work to reduce nuclear weaponry in a larger European context".

More than two-thirds of the Soviet naval construction and repair facilities are located in the Baltic Sea, and the traffic through the Danish straits is therefore rather heavy. The Soviet Northern Fleet, home based on the Kola Peninsula, sustains the Soviet global military posture, and is an important source of reinforcement for conflict areas and battlefields in the Third World.

About 70 per cent of all the Soviet ballistic missile submarines (SSBNs) are in the Northern Fleet. Accordingly, the Norwegian and Barents Seas are a high-priority arena for US and British ASW (anti-submarine warfare) activities. Conventional and nuclear land-attack cruise missiles are planned for deployment on US attack submarines by 1982 and 1984, respectively, northern European waters being one of the likely deployment areas. The United States also plans to upgrade the presence of carrier groups in the North Atlantic and the Norwegian Sea during the 1980s, as one element of a comprehensive forward strategy to be enacted throughout the decade [2, 3].

Northern Europe is therefore an increasingly important *arena* of international rivalry, although it is not itself a *source* of major power conflict.

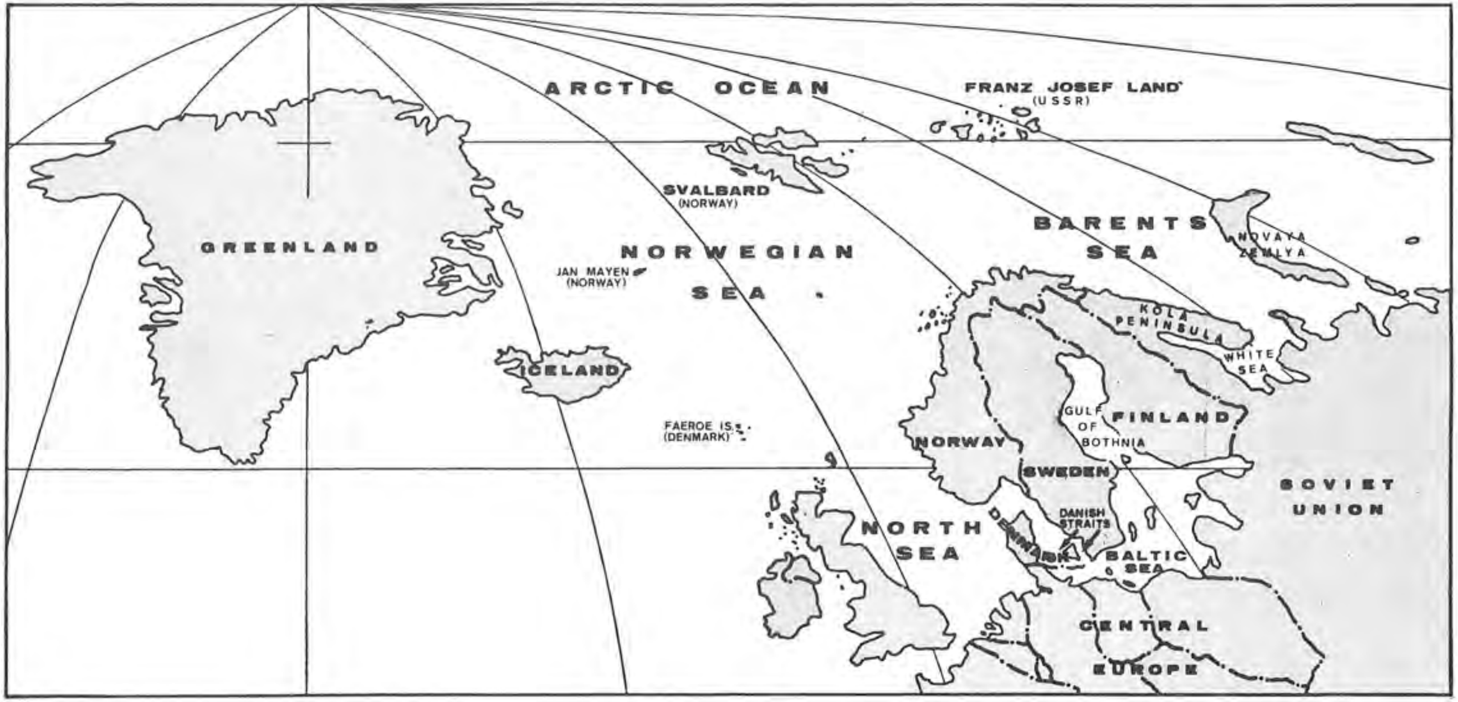
Against this background, a NWFZ may be an instrument by which the Nordic countries can exert some moderating influence on the military activities in their immediate surroundings. Any NWFZ in Europe would have the character of a buffer zone, and the elimination of nuclear weapons deployed in the vicinity of the Nordic countries and suitable for use against them would have to be part of the Nordic zone arrangement. However, for such deployment limitations to be realized, the major powers would have to see some common interest in avoiding tension in the area; they might then be interested in some zone design which serves that purpose.

III. Characteristics

There are three main characteristics of a NWFZ: non-possession, non-deployment and non-use of nuclear weapons. The non-possession requirement is already met by all the Nordic countries: they were among the first to ratify the Non-Proliferation Treaty (NPT). The non-deployment obligation, however, presents several difficulties for the two Nordic NATO members [4].

Norway and Denmark do not allow the deployment of nuclear weapons on their territories in time of peace. This is a unilateral measure of restraint; therefore, they are free to change policy at will, and options for the use of nuclear weapons on or from Danish and Norwegian territory have existed for years. Unlike the NPT commitment, this is a policy that can be changed

Figure 4.1. The northern European region



overnight. However, the broad consensus that has been formed around the non-deployment stand makes it hard for any government to back out of it under normal international conditions. Only a crisis could induce Norway and Denmark to ask for the transfer of nuclear weapons to their territories. Since the policy was instituted more than 20 years ago, technological developments have, moreover, rendered the exercise of the nuclear weapon option in time of crisis less important.

However, participation in a NWFZ would require an unqualified position against the deployment of nuclear weapons, applying in times of both war and peace, and embodied in an international legal instrument. While the policy of non-deployment in peace-time has never been challenged by other NATO members, non-deployment in wartime would impose a more substantial restraint on NATO nuclear planning for northern Europe. In important respects, Norway and Denmark would be decoupled from NATO's nuclear strategy, and their participation in NATO's military organization might have to be reconsidered also in other respects.

In the Final Document of the first UN Special Session devoted to Disarmament, held in 1978, the nuclear weapon states are called upon to respect the status of zones freely arrived at and to refrain from the use or threat of use of nuclear weapons against the states of the zone (so-called negative security assurances). In relation to the NWFZ established for Latin America by the 1967 Treaty of Tlatelolco, all nuclear weapon states have undertaken such obligations by ratification of an Additional Protocol to the Treaty, although with some important reservations [5]. A Nordic initiative for a NWFZ in Europe might follow that precedent, asking for negative assurances to be given in the same manner.

IV. The meaning of 'nuclear weapon-free'

'Nuclear weapons' usually means 'bombs and warheads'. By the established definition of a nuclear weapon-free zone, the prohibition applies to nuclear explosives only. It is in return for this prohibition that the nuclear weapon states are supposed to extend non-use assurances.

However, there are arguments for broadening the scope of a zone arrangement so as to prohibit other components of nuclear weapon systems as well.

It may seem artificial to single out bombs and warheads for exclusive attention and prohibition; rather, it could be argued that states from whose territories nuclear attack can be launched—because they have allowed nuclear explosive devices to be stationed on their soil or because they have permitted other vital components of nuclear weapons to be established on their territory—can only aspire to an assurance that they will not be subject to a *first* nuclear strike. Hosting important elements of nuclear weapon systems, they cannot be immune to a response in kind if a nuclear attack can be sustained from territory under their jurisdiction. After all, explosives are only one of the many necessary components of a nuclear weapon system. These components may figure on the nuclear targeting lists of adversary powers even if the territory on which they are located is declared nuclear weapon-free in the traditional sense.

If the NWFZ concept is limited to bombs and warheads, then there may be installations within the zone which could be used by another power in a nuclear attack, and which may figure on nuclear targeting lists, non-use guarantees notwithstanding. While there is no way of knowing that this is the case, military logic might indicate that it is, thereby detracting from the credibility of the guarantees. The established zone concept is clearly inadequate in this regard.

There are several examples of such installations presently in the Nordic area: navigation aids for submarines, communications-interception and direction-finding stations that can be used for target acquisition, and sonar arrays. The latter can be used by US Orion and British Nimrod aircraft carrying nuclear depth charges, and by attack submarines. However, these installations are all multi-purpose, and their actual significance for nuclear warfare can be disputed. It is often hard to determine whether a facility is an important part of a nuclear weapon system: this is a difficult task at any point in time, and the pace of military technological development makes it even more difficult to establish criteria for what is significant and what is not.

A zone arrangement must be perfectly clear as to rights and obligations: lack of clarity may lead to misunderstandings and suspicion, and guarantor states can make use of ambiguous provisions to exert pressure on member states. Clarity would appear to be an overriding concern. However, it is difficult to find an extended definition of denuclearized status which discriminates as clearly between things permitted and things prohibited as the distinction between presence and non-presence of explosives. This difficulty therefore amounts to a strong argument for sticking to the established meaning of 'nuclear weapon-free'. Should a country like Norway ever want to go beyond this and eliminate US or NATO-related facilities which may become nuclear targets in war, it could raise this question with other NATO members on a bilateral or alliance basis. In the NWFZ context, it would be another complication and, possibly, a major obstacle.

A zone arrangement implies, however, that all plans for the transfer of nuclear weapons to members of the zone must be scrapped. For instance, collocated operating bases (COBs) might be affected. The need for allied air support, essential for the defences of Norway and Denmark, must be made compatible with a credible non-nuclear status. This might be achieved either by changes in current agreements and practice, or by extended national verification rights, or by elements of both. At present, there are two Danish airfields in the COB programme and eight in Norway, in the total of some 70 for NATO Europe.

NATO members joining the zone may have to leave NATO's Nuclear Planning Group as well. Since they do not wish to be defended by nuclear weapons themselves, it might not be legitimate for them to participate in shaping the nuclear defences of other countries. On the other hand, in a nuclear war in Europe, the consequences would indeed be felt over the whole continent. Different countries would be differently affected, but there is no escape route for anyone. From that point of view, Nordic NATO members would still seem entitled to have a say in the formulation of nuclear strategies. The argument goes both ways.

Another implication of particular concern to NATO's nuclear weapon members is that a NWFZ could start a chain reaction that would shake the foundations of alliance nuclear strategy. Should Norway and Denmark drop out, the Netherlands may do the same, Belgium may follow suit, Greece may in any case drop out of the nuclear strategy, and so on. This is an important reason for US and British opposition to the zone proposals so far. It also explains much of the official West German reluctance, because it runs contrary to the German principle of non-singularity and the view that the nuclear burden should be shared among as many NATO members as possible. The more likely such a chain reaction is, the graver the Nordic reservations will seem, and the stronger the prospective sanctions against them, in terms of limitations on alliance participation and withdrawal of alliance support, will become. However, this might not be the case if the zone were to become part of a larger East–West rearrangement in Europe.

V. Geographical domain

In principle, the Nordic NWFZ proposals are *open-ended* in the sense that they allow for, invite or envisage more countries joining the zone as conditions become more propitious. They differ widely, however, concerning the initial domain of the zone.

As a first step in starting a process of denuclearization, it has been suggested that neutral countries such as Finland, Sweden, Switzerland and Yugoslavia could, unilaterally, reaffirm their nuclear weapon-free status and ask for affirmation of the non-use guarantees to which they are entitled [6]. More ambitiously, the starting-point could be Finland, Sweden, Norway and Denmark—including their territorial waters and airspace—although Danish security concerns are more tied to Central Europe than those of other Nordic countries, and therefore pose special problems (see section VII).[3] Iceland, another Nordic country, is in many ways less important for Western nuclear operations than Norway. But so far, the United States has not been willing to confirm that the Keflavik base is nuclear weapon-free, although the significance of the base for nuclear war-fighting purposes is commonly assumed to be on the decline. (Orion aircraft in the ASW role are becoming less dependent on nuclear depth charges.) The United States is also unwilling to confirm that nuclear weapons are not deployed at Thule and Söndre Strömfjord, Greenland; here, however, Denmark is in a rather good position to say whether they are or not, and except for the possibility of transit, these bases are virtually certain to be nuclear weapon-free.[4] For the rest of the Nordic area, the problem does not arise, essentially because the base policies of Denmark and Norway do not allow the stationing of foreign military personnel on their territories. For the zone to cover all Nordic territory—including Iceland, the Faeroe Islands and Greenland—a solution must therefore be found so that the Nordic countries can claim effective control over the entire area and reassure others that it is nuclear weapon-free. Of course, the nuclear weapon states must obligate themselves to respect the status of the zone, and thereby confirm that it is effectively free of nuclear weapons. The islands of Spitsbergen (belonging to Norway) and Aaland (belonging to Finland) have for several decades been demilitarized by treaty.

At sea, the territorial delimitation might follow the 12-mile rule. As for straits, the only strategically important strait in northern European waters is that leading into and out of the Baltic. Current Danish regulations demand that no more than three warships at a time can pass without special permission, and that submarines have to pass on the surface [8]. There is no special restriction on the passage of nuclear weapons. However, provisions for nuclear-armed warships may become desirable, depending on regulations to be agreed on nuclear weapon deployments in the Baltic Sea.

Territorial airspace is not clearly defined in international law. However, following the Warsaw Convention of 1929, it would reach as far up as modern planes can fly. Thus, intercontinental ballistic missiles are considered to travel in international outer space.

[3] Kekkonen's starting point was the 'continental areas' of Nordic countries, excluding Greenland and other islands as well as Iceland. A recent Soviet statement emphasized that Greenland ought to be part of the zone [7]. In a negotiation, the inclusion of Greenland might be traded against some similarly valuable Soviet concession.

[4] After the crash of a nuclear-armed B-52 aircraft near Thule in 1968, Denmark stressed that transit through the air territory of Greenland as well as storage of nuclear weapons on the island were prohibited.

VI. Transit provisions

The Treaty of Tlatelolco does not contain any provision regarding the transit of nuclear weapons. The Preparatory Commission for the Denuclearization of Latin America (COPREDAL) argued that it should be the prerogative of the territorial state, in the exercise of its sovereignty, to grant or deny permission for transit. In signing Additional Protocol II to the Treaty, the USA and France emphasized that each party to a nuclear weapon-free zone should retain exclusive legal competence to grant or deny transit. (This was motivated mainly by the use of the Panama Canal by the USA and other major powers.) In ratifying the same Protocol, the Soviet Union stated its objection to any such permission for transit.

For the Nordic countries, the transit of nuclear weapons mainly entails sea transit, except for Iceland (Keflavik). Even thus confined, it is a complex issue: it could involve a nuclear-armed ship showing the flag in a Danish harbour, ships participating in joint exercises, or an attack submarine calling at a Norwegian port for supplies or repair. Since large parts of the great power navies are equipped with nuclear weapons, it might be difficult for NATO members to prohibit all kinds of transit. An absolute prohibition could hamper joint military exercises to such an extent that allied support for Norway and Denmark would be seriously weakened. Such a prohibition would, moreover, be a rather one-sided concession on the part of Denmark, Norway and other Western powers.

The Soviet Baltic Fleet, and the significance of Soviet shipyards there, practically excludes prohibition of transit through the straits.

In the future, various kinds of air transit might also present great problems. Extended use by the United States of European airfields, including Danish and Norwegian, and extension of the Soviet air defence perimeter make the question more pertinent. In addition, there is the prospect of cruise missile transit, particularly the danger of cruise missile overflights of neutral air territory. Since Sweden and Finland can hardly defend themselves effectively against cruise missiles designed to penetrate Soviet air defences, political measures to counter this threat should be considered.

Under European 'buffer zone' conditions, the members of the zone cannot retain the competence to grant or deny transit as they please. The difference between a restrictive and a liberal practice would, under the circumstances, be too great to be left unregulated. Transits could, in theory, be so frequent that the basic non-stationing stand would be undermined. Transit provisions must therefore be negotiated.

Regardless of other zone provisions, overflights must be prohibited. In relation to cruise missiles, this could have some impact on the deployment of cruise missile carriers, making it less likely that the missiles would cross Nordic territory in time of war. SALT established functionally related observable differences (FRODs) for air-based systems, which made it possible to distinguish between B-52s with and without nuclear-loaded cruise missiles [9]. If such differences—related to cruise missile *carriers*—could also be established for sea-based systems, the obligations of nuclear weapon states could be made more precise, and the monitoring of adherence easier. However, this will be a very difficult task because some missiles will be submarine-based and others can be launched from standard tubes on a wide variety of surface vessels.

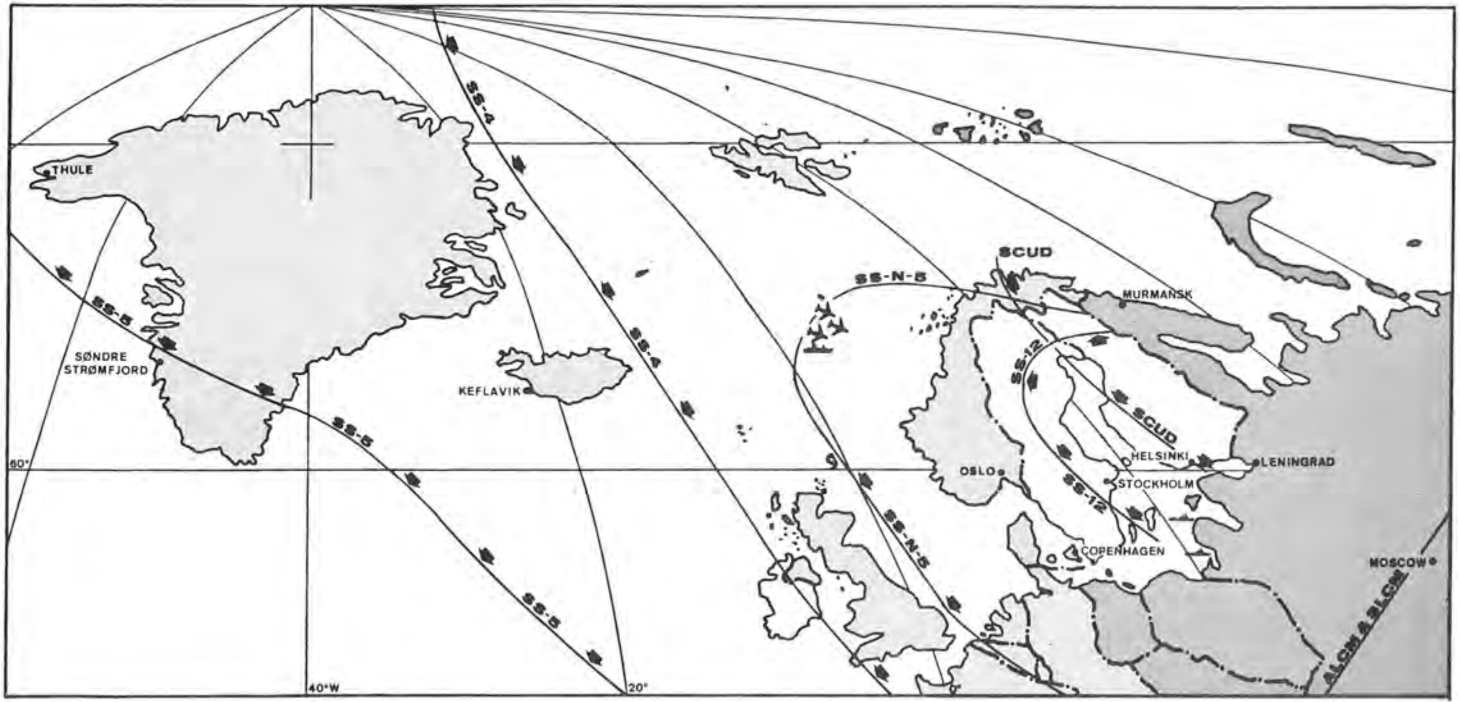
The missiles themselves have the same external physical characteristics whether they carry nuclear munitions or not, so it would seem that the overflight prohibition must apply to all cruise missiles, regardless of weapon load. However, since the deployment and movement of cruise missiles at sea are impossible to monitor with precision, and limitations extremely difficult to verify, a special treaty obligation to refrain from all plans and preparations that infringe on Nordic air territory might be the most that can be achieved. This obligation could be written into the Additional Protocol containing the guarantee for the zone, or into the provisions for deployment limitations in areas adjacent to the zone.

In general, the transit rules should be as strict as possible. However, it is even more difficult to prohibit in Europe activities which were not prohibited in the case of Latin America. The provisions regulating transit at sea have to be made both with regard to functional requirements for allied support to the NATO members in the area, and to the possibilities for verification. Formulation of the provisions would be complex but, provided that agreement is reached on certain political and military parameters, it might be relegated to a legal-technical operation of secondary importance.

VII. Deployment limitations in areas adjacent to the zone

In its foreign policy declaration of 18 March 1981, the Swedish government reiterated its long-standing view that a NWFZ agreement must include nuclear weapons "which are intended for targets within the zone, are stationed near the zone and have ranges of a scale which makes them best suited for targets within the Nordic area" [10]. Three months later, the Soviet Union stated its willingness to consider measures "applying to [Soviet] territory in the region adjoining the nuclear free zone in the North of Europe" [11]. Today, the viability of the zone proposals hinges very much on the prospects for deployment limitations in areas adjacent to the zone.

Figure 4.2. Target coverage of the Nordic area by NATO and Soviet missiles



There are two main perspectives on the issue of deployment limitations. First, such limitations may be seen as a consequence of the guarantees for the zone. To the extent that nuclear weapons are unambiguously directed at targets within the zone—because of their geographical position, range or other indicators—they have to be removed; otherwise, they would constitute proof that the guarantees are fictitious. For example, the dozen or so 800-km range SS-12 Scaleboard missiles in the Leningrad military district are, in all likelihood, intended for interdiction strikes against Nordic targets, because they do not reach continental Western Europe.[5] The 350-km range Scud missiles in the same district are primarily intended for use against Nordic territory as well, in a tactical role. Scuds and Scaleboards belong to the standard Soviet weapon inventory at the Army and Front levels, respectively.

The elimination of weapons in this category is of special significance for the Nordic countries. The history of wars shows that belligerents usually do not surrender until all weapons have been used. Thus, weapons which can only be used against Nordic countries may, in an extreme situation, be used even against militarily insignificant targets on Nordic territory, as acts of terror. It is true that the elimination of these weapons would leave the nuclear powers with thousands of other weapons capable of striking targets in the Nordic area; but given that they can be used for a variety of important missions in other parts of the world, it is not certain that they would be used against a nuclear weapon-free zone. For the Nordic countries, the elimination of weapons without competing targets elsewhere is therefore more important than their relatively modest numbers would indicate.

However, few weapons can be used against Nordic countries only. Modern weapon systems are usable over varying distances and against different targets: they are becoming more mobile and more flexible, and can therefore meet a broad spectrum of military needs. It may therefore be more appropriate to seek deployment limitations as a matter of militarily significant confidence-building measures.

Regarding Soviet nuclear weapons this would, firstly, be a question of limitations in the Baltic Sea. Primary candidates for elimination are the six Soviet Golf II-class submarines, carrying altogether 18 SS-N-5 missiles with a range of 1 200 km. Other Soviet submarines in the Baltic are also likely to carry nuclear weapons—nuclear-tipped torpedoes as well as cruise missiles—essentially for use against sea targets, but to some extent suitable for land attack as well.[6] For the Soviet Union, the military

[5] The location of the SS-12 brigade is not known. However, even if deployed in the southern parts of the Leningrad military district, it would not reach FR Germany.

[6] The Soviet Whisky-class submarine which violated Swedish territorial waters and was stranded outside the town of Karlskrona in October 1981 seems to have had at least one nuclear-tipped torpedo on board.

usefulness of these weapons seems to be rather low, and they are increasingly obsolescent. The Western powers are not known to have any permanent deployment of nuclear-armed submarines in the Baltic. Therefore, it may not be unreasonable to ask for a total ban on submarine-based nuclear weapons in this area.

With a similar ban on surface-ship weapons, permanent deployment of nuclear weapons in the Baltic Sea would be prohibited altogether. Only transit to and from the bases and shipyards would be allowed. However, this is a tall order: actually, it is hard to imagine that total denuclearization of the Baltic Fleet could be achieved within the framework of a NWFZ arrangement. Alternatively, a partial prohibition of surface-ship weapons well suited for land attack might be considered. Or it could be left to the nuclear powers involved as a matter of unilateral restraint. After all, the guarantees for the zone raise expectations for the nuclear powers to show restraint in areas adjacent to it.

Secondly, some weapons deployed in the Leningrad military district may be withdrawn. Elimination of the 10 SS-5 launchers deployed on the Kola Peninsula would be a militarily significant confidence-building measure, as would the elimination of Scud and Scaleboard missiles in the same district. In the Northern Fleet, four Golf II-class submarines are candidates for removal. These diesel submarines are not SALT-accountable.

Toward the south, deployment limitations would apply first of all to the Schleswig-Holstein area, where nuclear weapons are known to be deployed in large numbers, but also to the southern shores of the Baltic Sea in general, affecting the German Democratic Republic and Poland as well. In relation to a zone confined to the Nordic area, this may raise great difficulties, because the predominant weapon carriers are multi-purpose aircraft,[7] and because they are organic parts of the Central European theatre. Deployment limitations in this area might therefore have to be discussed in terms of disengagement zones for Central Europe, geographically contiguous to a Nordic zone [6]. Limitations to the south seem, in other words, to depend on the establishment of militarily significant confidence-building measures in a wider European area.

This is of particular relevance to Denmark, which is responsible, together with FR Germany, for the defence of Denmark, Schleswig-Holstein (including Hamburg) and the Danish straits under a joint command established for this purpose (Commander Allied Forces Baltic Approaches,

[7] As in so many other arms control contexts, the aircraft sector poses very complex problems: deployment of aircraft is flexible; combat radii depend on many factors; many of the aircraft are dual-capable; and consequently, the variety of possible missions is large. To institute effective, unambiguous operational limitations on these forces therefore requires much ingenuity. Indeed, the complexity of the issue could make negotiations for a NWFZ long drawn out and, at worst, deadlocked.

COMBALTAP). Danish participation in a Nordic NWFZ could have a disruptive effect on this co-operation, as long as the West German forces operate on the basis of the NATO nuclear strategy. Therefore, measures which would increase the effectiveness and credibility of Western conventional defences, leading to a reduction of the role at present assigned to nuclear weapons, would facilitate Danish adherence to a NWFZ. And, even better, it would also be facilitated by mutual force reductions and the establishment of disengagement zones in Central Europe.

Preventing weapon *modernization*—that is, the substitution of new missiles and weapon carriers for old ones—is even more important than eliminating *existing* weapons of the types mentioned above. The new generations of weapons have improved war-fighting capabilities and appear as more threatening. Deployment limitations are therefore important, primarily for the options they block for the future and secondly for the weapons that would be removed.

VIII. Verification

In the Treaty of Tlatelolco, the provisions for verification are essentially geared to horizontal proliferation—the danger that states in the region might acquire nuclear weapons of their own. In the case of a Nordic NWFZ, the main verification requirements would relate to vertical proliferation, reassuring all states concerned that agreed restraints on the nuclear systems of established nuclear powers are observed.

For the members of the zone, IAEA safeguards and the treaty obligation to remain nuclear weapon-free should suffice. Guarantor states should not be given any special right to monitor or interfere with the activities of zone members. This would be politically unacceptable for the Nordic states and, for Sweden and Finland, incompatible with their policy of neutrality.

The main problem is to verify that the deployment limitations are observed. While this is difficult to discuss until the limitations are determined, verifiability is an important parameter of the elaboration of restrictions.

One thing seems obvious: since the Nordic countries themselves do not possess adequate technical means of verification, co-operation with the guarantor states is important. Being parties to the same arrangement prescribing limitations and restraints on both sides, the great powers must be presumed to watch each other with the means they have at hand. By establishing a joint commission where all states involved may raise matters for clarification or submit charges of violations, the members of the NWFZ would be in a position to draw upon the verification capabilities of the guarantor states. New issues could be referred to the same commission for clarification, that is, to a multilateral setting, thereby avoiding bilateral exchanges between one or more Nordic countries on the one hand, and a nuclear weapon state on the other.

However, this does not mean that all desirable limitations would be verifiable. Nor does it mean that a violation would necessarily be brought before the commission upon detection. A prohibition of submarine-based nuclear weapons in the Baltic may, for instance, be effectively verified in relation to ballistic missile-firing submarines, but probably not in relation to nuclear torpedoes, mines or cruise missiles that can be deployed on attack submarines. In the Norwegian Sea, airborne cruise missiles can be effectively monitored, but the movements of cruise missile-carrying submarines cannot. And even if violations are discovered by the great powers, they may not always find it in their interest to pass the information on to the members of the zone; the likelihood of bilateral horse-trading may not be high, but the possibility does exist.

Rigid demands for verification have often blocked the adoption of arms limitation measures for lack of trust, or have been used as a smokescreen for predominant interests in continued arms build-ups. In a period of high tension and low confidence, the great powers may once again rule out deployment limitations on the grounds of verification, contrary to the interests of the Nordic countries. For the latter, treaty obligations sustained by *some* possibilities of verification may be preferable to no limitation at all. However, since the limits are to be placed on the great powers, they cannot be implemented against their will.

IX. The European connection

A Nordic zone can be seen as a measure in its own right, although open-ended; as such, it may also be a first step towards a more comprehensive reduction of the numbers and roles of nuclear weapons in the European security system. Alternatively, it may be seen as an integral part of a broad European rearrangement, its fate being tied to developments on the larger European scene [12].

A number of European connections can also be envisaged following the first approach. One is obvious: the Geneva negotiations on theatre nuclear forces include such weapons as SS-5 missiles (on the Kola Peninsula) and Golf II missile-carrying submarines (in the Baltic and with the Northern Fleet), which might therefore be removed within that framework as well as in the zone context. Should the negotiations make progress and lead on to nuclear weapons with a shorter range than 1 000 km, limitations could be achieved on a broader range of weapons, including many of those deployed in areas adjacent to the zone. In the same manner, or by the adoption of militarily significant confidence-building measures as a follow-up to the Conference on Security and Co-operation in Europe (CSCE) in Madrid, the withdrawal of nuclear weapons from Central Europe could, furthermore, tie in with the Nordic NWFZ arrangement and provide a solution to the deployment limitation problem on the southern edge of the zone. In any case, a Nordic NWFZ initiative should be presented to all states participating in the CSCE, and their views and comments taken into account. This might facilitate the extension of the zone at a later stage, and encourage disengagement measures in other parts of Europe.

Alternatively, the Nordic countries might declare their willingness to establish a NWFZ in the Nordic area within the framework of a broader European arrangement, as an offer or contribution to arms reduction in a wider European domain. Following this approach, deployment limitations would not be sought as a consequence of the guarantees for the zone, or as a confidence-building measure attached to it; the road to containment and reduction of the threat of nuclear weapons to the Nordic area would go via nuclear disarmament in the wider European domain. Consequently, realization of a nuclear weapon-free zone in the North would depend on substantial progress in East–West disarmament talks. The matter would be left to the great powers, subject to their interests and priorities and, eventually, to their negligence.

X. Collateral measures

Other measures to strengthen the security of Nordic countries, and to stabilize relations between the great powers in northern Europe, can also be envisaged. They may be considered separately, or in conjunction with the zone idea, as collateral measures.

In relation to the zone proposal, ASW operations carried out or supported from Norwegian territory may merit particular attention. ASW systems would, no doubt, be important targets in a nuclear confrontation between the USA and the USSR, and might therefore draw Norwegian territory into the warfare. Today, the main ingredients of ASW activities from Norwegian territory are sonar arrays and Orion aircraft. Various types of Sound Surveillance Systems (SOSUS) are deployed in the area between Spitsbergen and Finnmark in northern Norway. They may have been deployed further east as well, together with other listening devices scattered throughout the Barents Sea. Norwegian Orion aircraft patrol as far east as 45°, that is, almost to Novaya Zemlya. The flights are co-ordinated with British Nimrod and US Orion aircraft from the Pitreavie Headquarters for the Northern Maritime Air Region in Scotland [13]. In recent years, US interest in improving its ASW capabilities in the Barents Sea seems to have grown. To some extent, this can be achieved by the introduction of new, self-contained technology that does not depend on local shore stations [14]. However, a much upgraded US capability in the Barents Sea is hardly going to leave Norwegian territory unaffected. Since Western ASW activities in the Barents Sea are aimed at the mainstay of Soviet retaliatory forces at sea (the West has no sea lanes to protect in the Barents Sea, so it can hardly be a question of tactical ASW), Soviet countermeasures must be expected. This would intensify the arms build-up in the area and may lead to a strengthened Soviet forward defence for the Kola base and its SSBN force—to the detriment of the security of Nordic states. Therefore, in the double interest of maintaining mutually assured destruction and enhancing the security of Norway and other Nordic countries, Norwegian-based ASW activity might, for instance, be limited to 24° East—following the self-imposed restriction not to allow allied air and naval units to cross that meridian over Norwegian territory. A restriction of this kind—which would not impede the protection of Atlantic sea lanes—would have the character of a collateral measure, and could be offered by Norway for consideration within the total context of the rights and obligations instituted by the zone arrangement.

Other confidence-building measures have been proposed and associated with the NWFZ idea as well, including a demilitarized area along the Norwegian–Soviet border, a somewhat broader area with agreed limits on military forces, and a political guarantee from Norway, Sweden and Finland that a conventional attack on Murmansk would not be allowed over their territories [15]. To the extent that the two major powers are still interested in maintaining mutual assured destruction, the vulnerability of the naval bases on the Kola Peninsula ought to be of concern for the United States as well. The more restraint the Western powers are willing to exercise and institute, the more far-reaching are the deployment limitations that can be asked of the Soviet Union and, consequently, the more substantial would be the restrictions on forces suited for attack on Nordic countries.

XI. Prospects and procedures

The Nordic NWFZ idea is of political interest because it has received remarkable public support in all the Nordic countries.

Norway and Denmark would, as a matter of course, have to consult with their allies on the drawing up of any zone arrangement. Equally obviously, the Nordic countries themselves must kick the ball off by taking a joint decision to initiate a process aiming at the establishment of a nuclear weapon-free zone in northern Europe. The decision might be taken at a meeting of Nordic foreign ministers. Iceland, a Nordic country and a regular participant in Nordic ministerial meetings, naturally ought to take part. Should Icelandic membership in the zone be considered premature, the meeting might underline the desirability of including Iceland at a later stage. Accordingly, it might also wish to emphasize that actions drawing Iceland deeper into Western nuclear strategy, as compensation for the denuclearization of Norway and Denmark, should be avoided.

Alternatively, the process could be initiated by co-ordinated declarations of all the countries to be included in the zone. One way or another, the constitution of the zone must be a Nordic initiative, even if it were to be presented as a Nordic offer to the great powers and other European states in the pursuit of arms reductions in the wider European domain. Otherwise, it would not carry much weight on the diplomatic scene.

Should the zone be seen as a measure in its own right, or as a first step towards a more comprehensive rearrangement in Europe, the Nordic NATO members would become involved in a sensitive balancing act between membership in the zone, on the one hand, and continued NATO membership on the other. On the one hand, they would have to meet the non-deployment demand and discontinue all preparations for transfer of nuclear weapons to their territories in time of crisis or war. On the other hand, the initial, rudimentary design must be of such a character, and have enough built-in flexibility, that the United States and NATO can accommodate the new conditions. If the United States declines to give guarantees for the zone, and if NATO balks at the alliance obligation to render support if limited to conventional means only, the zone is unlikely to be established.

It is hard to assess how difficult it would be to reconcile the two: no one knows precisely where the meeting points would be until negotiations have been held. There is no doubt that negotiations would raise great demands on the Nordic governments and foreign services in terms of both firmness and diplomatic flexibility.

XII. Concluding remarks

Deployment limitations in areas adjacent to the zone are crucial for the popular support and the ensuing vigour with which the Nordic countries will pursue the zone idea. With such limitations the significance of a NWFZ would be recognized even in peace-time.

In essence, the arrangement would be a militarily significant confidence-building measure, although more important politically than militarily. In time of crisis, it would function as an early-warning system—in the political rather than in the military sense. The procedural provisions regarding withdrawal or suspension of treaty obligations might play an important role here, and should be drafted so as to enhance the early-warning role. While the credibility of the guarantees in time of war would remain open to doubt, this question would become less important in the overall assessment of the merits of the arrangement because, to a large extent, the merits would be apparent in times of peace and crisis.

The composition of the limitation package is decisive for the consent and co-operation of the great powers. Above all, a balance must be struck which is compatible with the interests of the USA and the USSR. The elements to be balanced might be an unconditional Danish and Norwegian non-deployment stand, restraints on the movement of cruise missile carriers, and unilateral, collateral measures in return for Soviet arms reductions in the Baltic Sea and the Leningrad military district.

If there is no progress in the negotiations on long-range theatre nuclear forces at Geneva, it will be difficult to get any deployment limitations in the North: that would go against the general trend. If, on the other hand, the Geneva negotiations succeed, the need for separate limitations in northern Europe might gradually diminish, and the special restrictions to be attached to the zone made more manageable for the parties and the guarantor states to negotiate.

The case for disengagement in northern Europe is strong. The alternative to a zone arrangement—or to other arms limitation measures, for that matter—is not the *status quo* in northern Europe, but a big increase in military capabilities in the area. The latter would lead to increased tension and make the Nordic countries more vulnerable to great power confrontation elsewhere in the world, through the possible escalation and spread of armed conflict to the north of Europe.

The evolving growth and spread of more effective nuclear war-fighting weapons to the north of Europe underline the need for new measures to maintain a state of low tension in the area. At the same time it makes it more difficult to carry out such measures. It is not difficult to conceive of a NWFZ arrangement which would strengthen the security of the Nordic countries: the problem is to find a design which is acceptable to the major powers as well. This is but one example of a general, dialectic phenomenon in contemporary European affairs: while the arms race is more intense than ever before, at the same time public opinion against it is stronger than it has been for decades. It remains to be seen whether trends can be reversed; but the surging public interest in arms reduction, and in nuclear disarmament in particular, gives a glimpse of hope for the future.

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Part II. Developments in world armaments in 1981

5. World military expenditure and arms production

Square-bracketed numbers, thus [1], *refer to the list of references on page* 126.

I. Introduction

World military spending has continued to rise, in real terms. Indeed the rise through the last four years—at something like 3 per cent a year—has been, if anything, rather faster than in the first half of the 1970s. This is in spite of the deteriorating performance of the world economy: world economic growth has slowed down considerably in recent years. So the burden of world military spending—measured as a share of the world's total output—has probably been rising.

It is never easy to know how best to give an impression of the size of the world's military budget. The dollar is still the standard measuring-rod used, yet it is difficult to find sensible ways of converting the military spending of Socialist countries into dollars. For what it is worth, the dollar total in 1981—at current prices—was of the order of $600–650 billion.

The main change—which has now begun—is in the United States. After a fairly long post-Viet Nam period in which US military spending was falling in real terms, it is now set to rise rapidly—and indeed has begun to do so. A formidable rearmament programme is in prospect—so formidable that some commentators believe that it will eventually be cut back because of the economic difficulties it creates.

The United States has not been successful in persuading its NATO allies to follow suit. Indeed the rise in NATO Europe's military spending has been fractionally slower in the past four years than in the previous four, and there is little in the 1982 budgets to suggest any substantial change. Japan has also been resisting US pressure to spend more than 1 per cent of the Japanese national product on defence. If these divergent trends continue—of rapidly rising military expenditure in the United States, with much smaller rates of increase in Western Europe and Japan—this is bound to create tension in the Western alliance.

There does not appear to have been any particular change in trend in Soviet military spending: high figures have continued for the output of military hardware, with a steady upward trend which does not seem to vary much from year to year.

There does seem to have been some change in the trend in India and Pakistan, where the rise in military spending has accelerated in the past two years—coupled with increased supplies of weapons from the two great powers. Australia has reacted to the general increase in world tension with a rearmament programme. In the Middle East and the Persian Gulf, perhaps the main change has been the increase in the flow of military aid; both great powers continue to supply substantial quantities of weapons. In Egypt, Oman and Somalia, the United States, in exchange for military aid, is proceeding with the construction of various base facilities.

The one major country which is following a different course is China. The Chinese view is clearly that there is no imminent threat; the military budget has been cut back substantially, in the interest of the civil economy.

The sections which follow concentrate this year on the major countries—the USSR, the USA, the main countries in Western Europe, China and Japan. (Developments in intercontinental strategic weaponry are dealt with in chapter 7.) Shorter notes follow on some other selected areas of interest. A final section briefly discusses multinational weapons production. Appendix 5A provides one small example of weapon development, as an illustration of the process—and it takes for this purpose the Maverick and Condor air-to-surface missiles.

II. The Soviet Union

There is the usual dearth of hard information from the Soviet side on the Soviet Union's military expenditure or production; as usual, the figures in this section come from Western sources. If these figures give the wrong impression, it is for the Soviet Union to correct that impression by releasing more information. In a world of satellite photography, the Soviet Union's all-pervading secrecy does little to conceal its military capabilities from the United States.

In the course of 1981, the US Department of Defense published a book entitled *Soviet Military Power*. It was widely distributed in Western Europe as part of a campaign to persuade West European audiences that there is a genuine Soviet threat. The message of the book is summed up in a preface by the US Defense Secretary as follows:

> All elements of the Soviet Armed Forces . . . continue to modernize with an unending flow of new weapon systems, tanks, missiles, ships, artillery and aircraft. The Soviet defence budget continues to grow to fund this force build-up, to fund the projection of Soviet power far from Soviet shores and to fund Soviet use of proxy forces to support revolutionary factions and conflict in an increasing threat to international stability. [1]

The general impression given by this book is of a perfected military machine: indeed it has been described as an excellent public relations document for the Red Army. There are very few references to weaknesses or inadequacies. Such a degree of perfection is unlikely. The Soviet civil economy is known to be inefficient, with low productivity and under-used capital equipment. The military sector may be more efficient than the civil sector, but it is not likely that it wholly escapes the defects which pervade the rest of the economic system. There is indeed some evidence within the military sector on this point. It is frequently asserted that the Soviet Union devotes more resources than the United States to military research and development, with many more scientists and engineers engaged in military work. If this is the case, then the Soviet resources must be used in a relatively inefficient manner, for it is not disputed by the US Department of Defense that the United States continues to have a significant lead in most areas of military technology.

The book sets out some figures of Soviet output of various items of military hardware (table 5.1). These figures in general show high *levels* of output. They do not, in general, show sharply rising *trends*. Some of the figures do indeed show production rising—from 900 pieces of towed field artillery in 1976 to 1 300 pieces in 1980, for example. At least as many show declining rates. Under the constraint of the SALT I and SALT II agreements, the production of intercontinental ballistic missiles has come down

Table 5.1. US Department of Defense estimates of Soviet output of certain military items

Military item	1976	1977	1978	1979	1980
Ground forces materiel					
Tanks	2 500	2 500	2 500	3 000	3 000
Other armoured fighting vehicles	4 500	4 500	5 500	5 500	5 500
Towed field artillery	900	1 300	1 500	1 500	1 300
Self-propelled field artillery	900	950	650	250	150
Multiple rocket launchers	500	550	550	450	300
Self-propelled AA artillery	500	500	100	100	100
Towed AA artillery	500	250	100	–	–
Aircraft					
Bombers	25	30	30	30	30
Fighters/fighter-bombers	1 200	1 200	1 300	1 300	1 300
Transports	450	400	400	400	350
Trainers	50	50	50	25	25
ASW	5	10	10	10	10
Helicopters	1 400	900	600	700	750
Missiles					
ICBMs	300	300	200	200	200
IRBMs	50	100	100	100	100
SRBMs	100	200	250	300	300
SLCMs	600	600	600	700	700
SLBMs	150	175	225	175	175
ASMs	1 500	1 500	1 500	1 500	1 500
SAMs	40 000	50 000	50 000	50 000	50 000
Naval ships					
Submarines	10	13	12	12	11
Major combatants	12	12	12	11	11
Minor combatants	58	56	52	48	52
Auxiliaries	4	6	4	7	5

Source: Soviet Military Power, US Department of Defense, 1981.

from 300 to 200 between 1976 and 1980. For most of the other series the trend in simple numbers (which, because of the process of product improvement, is of course an inadequate measure by itself) is flat.

This impression of roughly constant output in numbers is reinforced by examining some of the figures for periods earlier than 1976, which are not given in this book. It appears that as far back as 1966 the Soviet Union was producing 3 500 tanks a year—a figure which rose to around 4 500 in 1970, and has since fallen back to the current rate of around 3 000 [2]. In shipbuilding, if we take the production of major surface combatants—cruisers, destroyers and frigates with a displacement larger than 1 000 tons—we find the peak in numbers was in 1953, when some 40 such ships were delivered. These were, of course, much smaller, cheaper, less sophisticated vessels than the ones now being built. Soviet output of these much larger, more complex ships is now running at a fairly steady rate of about five a year, with an output of about six a year of a class of corvettes, of just under 1 000 tons, called Grisha; this makes up the figure of 11 for major combatants in table 5.1 [3].

In the Soviet Union, therefore, as in Western countries, the increase in output of military hardware is not properly measured by crude numbers of weapons; it is the process of product improvement which is all-important, as new, more sophisticated models replace old ones.

The Soviet Union has traditionally relied on large quantities of simple, durable and relatively cheap weapons well-suited for mass production. The continuity of political and military leadership facilitates the long-term planning of research and production. This means that arms production in the Soviet Union follows a model-by-model type of development. Proven weapon systems are further developed and refined into new and more sophisticated versions. By using this method, existing production lines are easily converted to production of the new model and steady production can be maintained. So the more capable weapons are produced at much the same rate as their technologically inferior predecessors.

The burden that this massive military programme imposes on the Soviet economy must be the more noticeable now that the Soviet economic growth rate has slowed down. The Soviet gross national product (GNP) was rising at an average annual rate of 6 per cent during the 1950s; this declined to 5.2 per cent in the 1960s, to 3.8 per cent in 1971–75, and to 3.1 per cent in 1976–79. Many forecasters expect a further slow-down. The Soviet economy is plagued by lagging productivity, labour shortages and food shortages. The East European economies in general have incurred very substantial debts to Western bankers, and it is generally believed (rightly or wrongly) that the Soviet Union could not allow them to default. The support of the regimes in Cuba, Viet Nam and, more recently, in Poland is proving increasingly costly. In a planned economy, with labour shortages, the opportunity cost of military expenditure—that is, the cost measured in terms of civil production forgone—is more immediately apparent than it is in Western economies where at present there is substantial unemployment and substantial spare capacity. It stands to reason that those persons and institutions which are concerned with the performance of the civil economy must covet some of the resources devoted to the military sector.

Certain comparisons

The book on Soviet military power provides virtually no comparison with the military capabilities of any other country; yet power is, of course, essentially a relative concept. Comparisons simply between the Soviet Union and the United States are too limited. As a recent US Senate Committee report comments:

> . . . The Soviets may see themselves as surrounded by hostile forces with no strong allies to assist them. Of the sixteen nations with the largest defense budgets as of 1978, seven, including the United States, are members of NATO, one (Japan) has a bilateral defense treaty with the United States, and three (China, Saudi Arabia and Israel) are strongly anti-Soviet or pro-Western in orientation. Only three of these countries (USSR, East Germany, and Poland) are members of the Warsaw Pact, another (India) is pro-Soviet in orientation . . . Soviet fears of the People's Republic of China (PRC) have grown in the last three years as the PRC improved her relations with Japan and the United States. These developments are likely to be seen as highly unfavourable to the Soviets. Moreover, the Soviets have failed to improve their cool relations with Japan which has been a major foreign policy setback for them. [4a]

Comparisons, in short, must take account of the Soviet Union's long border with a country which it considers hostile—China; they must also take account of the extent to which the military expenditure of the NATO countries in Europe exceeds that of the East European members of the Warsaw Treaty Organization (other than the Soviet Union). It further appears that the military capabilities of Spain will soon be added to the NATO total.

In sum, the USSR and the other WTO countries maintain an output of larger quantities of conventional weapons than the United States and NATO. These weapons are much more sophisticated than a decade ago; nonetheless the technological lag is still there. Economic growth rates in the Soviet Union and in WTO countries in general have slowed down considerably: the economic cost of military output, in terms of civil output forgone, is likely to become increasingly disturbing.

Power projection

During the last two decades the Soviet Union has clearly set itself to become, like the United States, a true world-wide power. The construction of a navy with ocean-going capacity has been a central part of this programme. In the early post-war years, the Soviet Navy was simply a coastal force consisting of small ships such as fast patrol boats and corvettes. The Soviet Navy is now second only to that of the United States. In recent years, the strength and range of the surface fleet have been greatly increased by the entering into service of two Kiev-class aircraft carriers, the 40 000-ton Berezina fleet replenishment ship, one Kirov-class nuclear-powered missile cruiser, the 13 000-ton *Ivan Rogov* amphibious landing ship and Sovremennyj- and Udaloy-class destroyers. These lead ships and those that will follow give the Soviet Union a much greater peace-time 'power projection' capacity than it had before. However, this capacity is still much inferior to that of the United States. For instance, while the total aircraft carrier force of the Soviet Union consists of two 37 000-ton ships carrying 12–14 Yak-36 carrier-based fighters, the United States has some 14 aircraft carriers with an average displacement of approximately 70 000 tons, each of which takes 70–90 naval aircraft. The Naval Air Force of the Soviet Union consists of approximately 755 aircraft while the Naval Air Force of the United States consists of some 1 450 aircraft. The amphibious assault and tank-landing capacity of the Soviet Navy is very limited compared to that of the United States, and the United States is clearly better placed in naval logistics. The USSR has increased its access to certain facilities—as in Ethiopia and South Yemen—which it did not have before; however, the United States is clearly in a better position as regards the total number of bases, and obviously in the number of ice-free ports. The Senate Committee on Armed Services concluded, in a report published in 1981:

> At the present time, the United States has substantial advantages over the Soviet Union in traditional power projection forces. The United States is far more capable of inserting and sustaining a military force in distant areas. While the Soviets have large airborne forces and a militarily more capable merchant marine—especially in terms of its coordination with naval forces—the majority of Soviet forces suitable for power projection are embryonic compared to US forces. The US advantages in sea-based tactical air, amphibious forces and shipping, airlift and in-flight refuelable aircraft are substantial. However, some of these advantages are offset, at least in part, by the greater proximity of the Soviet Union to key world trouble spots—the Persian Gulf, Middle East, and Korea. [4b]

Research and development

The Soviet Union has in the past decade been attempting, with its very substantial research and development programme, to reduce the United States' lead in military technology. Some results of this can be seen, for instance, in the improved capabilities of Soviet tactical aircraft. Traditionally, these consisted of relatively simple short-range interceptors such as the MiG-21, primarily intended for defence purposes. The new

MiG-23/27s, MiG-25s and SU-24s all have higher speeds and payloads, more sophisticated electronics and longer range. However, they still lag technologically behind the US aircraft.

Indeed the US Department of Defense, in its assessment of the Soviet Union's relative position, which is published in *Soviet Military Power*, suggests only two or three technological areas in which the Soviet Union might have a lead. These are direct-energy weapons such as high-energy lasers, chemical warfare and some radio frequency devices. In the rest the United States' lead remains. For example the report states "The United States remains the world leader in the field of micro-electronics and computers . . . The average relative position or 'gap' is 3–5 years with a few outstanding developments following US technology by only 2 years, and some problem areas lagging by as much as 7 years" [1]. Systems using micro-electronics and computers are at the core of modern weapon technology, and will continue to be so in the foreseeable future.

III. The United States

Before President Reagan came to the White House, the decision had already been taken by the Carter Administration to increase US military spending substantially in real terms. President Carter, in his five-year defence projection presented in January 1981, put forward an initial 8 per cent rise in the military budget for the fiscal year 1981 with a 5 per cent growth path thereafter.[1] This was a dramatic change in trend from the course of military spending in the previous decade. From 1968 to 1975–76 US military spending was coming down from its Viet Nam peak. It then stayed roughly constant, in real terms, up to the turn of the decade.

The Reagan Administration, given that it had campaigned on the inadequacy of President Carter's defence plans, had little choice but to move the numbers up, and did this in its revised March budget. This budget put in a volume increase in total obligational authority of 12.4 per cent in 1981, and 14.6 in 1982, with a 7 per cent real growth rate thereafter. This figure of 7 per cent seems to have been put in on the basis that it was 2 per cent higher than President Carter's figure. It was not based on any costing of proposed programmes—these were to be filled in to take up the money later. As Mr Stockman, the Director of the Office of Management and Budget, acidly but indiscreetly remarked "The defense program . . . was just a bunch of numbers written on a piece of paper" [5].

[1] These are the figures for Total Obligational Authority—the amount the Administration is asking Congress to authorize it to spend. A good part of these authorizations will be for actual spending in subsequent fiscal years, so actual outlays lag behind the figures for obligational authority.

These very big increases in total obligational authority in 1981 and 1982 would, if realized, produce large increases in actual outlay in 1983–85 (table 5.2). The new budget proposed by the Administration for the fiscal year 1983 requests an increase in total obligational authority of 13.2 per cent, after adjustment for inflation. The new five-year projection envisages an average increase in actual outlays, in real terms, of over 8 per cent annually from now to 1987. It seems quite likely that this year there will be a stronger Congressional opposition to the Administration's proposals. However, unless there is a very radical change in policy, there is no doubt that big increases are in process for US military spending. The beginning of the new trend is already there. NATO estimates of US actual military outlay show a 3.7 per cent volume rise in 1980, and a 5.9 per cent preliminary estimate for 1981.

Table 5.2. The United States military budget: five-year projections

Budget	1981	1982	1983	1984	1985	1986	1987
President Carter's January 1981 budget							
Total obligational authority in current dollars (billion)	171	196	224	253	284	318	–
Real growth (percentage)	*7.8*	*5.3*	*5.0*	*5.0*	*5.0*	*5.0*	–
President Reagan's March 1981 budget							
Total obligational authority in current dollars (billion)	178	222	255	289	326	367	–
Real growth (percentage)	*12.4*	*14.6*	*7.3*	*7.0*	*7.0*	*7.0*	–
President Reagan's January 1982 budget							
Total obligational authority in current dollars (billion)	–	214	258	285	332	368	401
Real growth (percentage)	–	*12.7*	*13.2*	*4.6*	*10.4*	*5.4*	*3.8*
Estimated real growth in outlays (percentage)	–	*7.7*	*10.5*	*8.0*	*9.6*	*8.0*	*4.6*

Note: These figures do not include the nuclear part of nuclear weapons, estimated at $4.5 billion in 1982, or military aid, estimated at $1 billion in 1982.

Source: Department of Defense Authorization for Appropriations for Fiscal Year 1982; Defense Daily, 9 February 1982.

Three issues about this substantial rearmament programme are considered here. The first concerns the reasons for its adoption. Secondly, there is the question of the form which the programme takes. Thirdly, there is a discussion of the economic consequences.

Reasons for adoption

The decision to change the trend in US military spending was not a reaction to any assumed change in trend in the Soviet Union. The CIA's estimates of Soviet military spending have for a very long time shown a steady and relatively unvarying upward trend. On the basis of the CIA figures, US Secretaries of Defense have indeed argued that the Soviet Union was outspending the United States—an argument summed up in the phrase 'When we build, they build; when we stop building, they build'. However, there is nothing new about this argument—and in fact in recent years it has come to be more widely accepted that the CIA's dollar estimates of Soviet military spending produce an overstated figure. Further, even on the CIA figures, total NATO military expenditure exceeds that of the WTO—and that is without including China's military spending.

The change in trend was rather the consequence of a change in public attitudes in the USA towards foreign policy and towards defence. This change has been summarized as follows:

By the end of 1980, a series of events had shaken us out of our soul-searching and into a new, outward-looking state of mind. The public had grown sceptical of detente and distressed by American impotence in countering the December 1979 Soviet invasion of Afghanistan. It felt bullied by OPEC, humiliated by the Ayatollah Khomeini, tricked by Castro, out-traded by Japan and out-gunned by the Russians. By the time of the 1980 presidential elections, fearing that America was losing control over its foreign affairs, voters were more than ever ready to exorcise the ghost of Vietnam and replace it with a new posture of American assertiveness.

Americans have become surprisingly explicit about how the United States should seek to regain control of its destiny, and in the context of the disquieting realities of the 1980s, these ideas created a new, different and complex foreign policy mandate for the Reagan presidency. The national pride has been deeply wounded: Americans are fiercely determined to restore our honor and respect abroad. This outlook makes it easy for the Reagan Administration to win support for bold assertive initiatives, but much more difficult to shape a consensus behind policies that involve compromise, subtlety, patience, restrained gestures, prior consultation with allies, and the deft geopolitical manoeuvring that is required when one is no longer the world's preeminent locus of military and economic power. [6]

This change in public attitude is statistically recorded in the Gallup poll which is regularly conducted on the public's views about defence. The response to a question on defence spending, expressed as a percentage of total replies, is shown below:

	1969	1976	1980
Too much	52	36	14
About right	31	32	24
Too little	8	22	49

The nature of the programme

To justify a drastic expansion of military expenditure (which was already scheduled to rise fast), the new Administration might have unveiled a new strategy. It did not do so: rather it has gone for an across-the-board increase in the acquisition of new weapons. The new Secretary of Defense told the Senate Armed Services Committee: "The principal shortcoming of the defense budget we inherited is not so much that it omitted critical programs entirely in order to fully fund others but rather that it failed to provide full funding for many programs it conceded were necessary but felt unable to afford" [7].

The programme includes big increases in expenditure on strategic nuclear weapons, the build-up of a much bigger navy and increases in the firepower and mobility of the Army and the Marines. The strategic nuclear weapon programme is discussed separately in chapter 7. The other two areas of increased expenditure have as their main purpose an increase in the ability of the United States to project its power in parts of the world which are distant from the US continent. The Secretary of Defense stated that the United States must be able to defend itself in "wars of any size and shape and in any region where we have vital interests . . . Our global interest and commitments dictate that our armed forces acquire greater range, mobility and survivability . . . That means naval power able to command the sea lanes vital to us and our allies. It means developing urgently a better ability to respond to crises far from our shores and to stay there as long as necessary" [8].

For the Navy, the aim is to reach a 600-strong fleet by 1987: that means procuring some 143 combat ships. The long-term plan includes two new nuclear-powered aircraft carriers as well as the reactivation of four battleships and two aircraft carriers, 14 new attack submarines of the Los Angeles-class and some 1 900 aircraft, mainly F-18 fighters. For the fiscal year 1982 the main items include funding for one new aircraft carrier, reactivation of the World War II battleships *Iowa* and *New Jersey*, Aegis-class missile cruisers, and FFG 7-class frigates. Thirty F-14 and 63 F-18 carrier-based fighter aircraft will be procured during the fiscal year.

The additional funds (over and above the Carter budget) requested for the Army and the Marines are mainly intended for the Rapid Deployment Force, the emergency task force for rapid military operations abroad, primarily in the Middle East and the Indian Ocean. The fiscal year 1982 programme includes M-1 and M-60 tanks, M-2 infantry fighting vehicles, divisional air defence systems (DIVAD), attack helicopters, transport aircraft and AV-8B Harrier short take-off and landing (STOL) fighters.

One general consequence of the nature of the programme is an increase in the share of procurement in total US defence expenditure—from 24 per cent in 1980 to 30 per cent in 1982.

The major share of the new military orders will naturally go to the established defence contractors. McDonnell-Douglas is involved in three major aircraft programmes, namely the F-15 Eagle, the F-18 Hornet (in partnership with Northrop) and the AV-8B Harrier (in partnership with British

Aerospace). General Dynamics is producing the F-16 fighter for which the US Air Force alone has an order for 1 388 aircraft; the company is also building the Ohio- and Los Angeles-class nuclear submarines, as well as manufacturing various ship-borne missile systems. Tenneco is responsible for the construction of nuclear aircraft carriers, Chrysler is the main contractor for the M-1 Abrams tank, and Raytheon and Hughes manufacture Maverick, Phoenix, Sparrow and Sidewinder airborne missile systems. They are also co-developing the new NATO medium-range missile called AMRAAM.

The economic consequences

There has been considerable debate in the United States about the economic consequences of this military spending programme, with some economists arguing that it will wreck the economy and others saying that it can be accommodated with no great difficulty. These are some of the points made in that debate:

1. First of all, there is the question of whether the programmes which have been launched will not demand even larger budgets than those now put forward. One virtually universal characteristic of weapon procurement programmes is that they overrun their initial estimates. The average cost overrun of major programmes—not including inflation and quantity changes—has been put at nearly 52 per cent; the chance of a major programme being completed within its initial cost estimate is about one in ten. There will almost certainly be strong pressure from the three services for higher budget allocations.

2. There is, of course, no dispute that this programme will raise the share of military expenditure in the national product. However, how big that rise will be depends crucially on the rate of growth of US GNP: and this, in turn, will depend very largely on the extent of the recovery (if any) in the United States' productivity trend. In recent years, productivity in the United States has hardly been rising at all. The Reagan Administration claims that its 'supply-side' policies will rejuvenate US productivity: many economists doubt it. If productivity recovers to a 3 per cent trend, military spending (in the present programme) will go up from 5.7 per cent of GNP in 1981 to 7.1 per cent in 1986. If there is no recovery in productivity, that 1986 figure becomes 8.1 per cent [9].

3. The critics who suggest damaging economic consequences from this military programme do so mainly on the basis of the general economic policies which, under the present Administration, seem likely to accompany it. The critics do not dispute that, with appropriate economic policies,

room could be made in the economy to allocate 7–8 per cent of the national product to military spending. It is still, after all, a lower percentage than the average for the 1950s, which was around 10 per cent. However, unless there is substantial spare capacity in the economy (a point discussed below) a relative increase in military demand for resources requires policies to produce a relative decrease in civil demand. The Reagan Administration, it is true, is proposing reductions in federal civil expenditure: however, it is also proposing reductions in tax rates.

4. The inflationary dangers from the proposed military programmes are twofold. There is, first, the 'bottleneck inflation' which comes from specific shortage of materials or skilled personnel needed for these weapons programmes and, secondly, there is also the risk of general excess demand inflation. The first of these is virtually certain, the second is more controversial.

In the period when weapon procurement in the United States stagnated, many sub-contractors who had previously been largely engaged in military work turned to civil production. As a result, when military orders increased, bottlenecks appeared as early as the autumn of 1980. A Congressional Committee received testimony at that time, that "from 1976 to 1980 the typical delivery span of aluminium forgings increased from 20 to 120 weeks . . . From 1977 to 1980 the delivery span for aircraft landing gear grew from 52 to 120 weeks . . . In spite of the recession and its attendant unemployment, there remains a shortage of skills needed by the defense industry. The shortage leads to competition for labor and upward pressure on costs" [10]. It is probable that, with the deepening recession since 1980, these delivery times will have shortened. Once the economy begins to recover, they could soon lengthen again.

Whether general excess demand inflation will follow from these programmes is more controversial. There is no consensus estimate in the United States of the extent of spare capacity in the economy now; nor, of course, is there a consensus view among economists about the determinants of inflation. Some will regard the federal budget deficit as the crucial figure in this regard; others will look rather at the figure for unemployment, as a general measure of the pressure of demand. It would not be sensible to attempt to make a five-year forecast of the course of unemployment, simply on the basis of the military expenditure programme.

5. Finally, there is the question of the effect of the increased demand for weaponry on US high-technology civilian industries, as materials, equipment and skilled personnel are moved from civilian to military pursuits [11]. This does seem likely to do some damage to the ability of the USA to compete in world markets, and unless the USA turns to more trade protection there will be a loss of share in the home market as well.

For the United States is the only Western industrial country which is rearming rapidly. In Western Europe, and more particularly in Japan, the demands of military high technology will not be bidding resources away from the civil sector. US high-technology firms which produce civil products will find it increasingly hard to hold on to their markets.

The future course of US military spending is much more likely to be determined by these economic factors, and by any consequent changes in public attitudes, than it is by any sophisticated analysis of the Soviet threat.

IV. The NATO targets

In May 1977 NATO countries collectively agreed to begin to move their military expenditure up to a 3 per cent real growth trend; this undertaking was repeated in May 1978, and again in May 1981, when the period was extended to 1987. When ministers agreed on these 3 per cent growth targets, they probably thought that there were clear and unambiguous figures for volume increases in military expenditure. This is, after all, a very common view among those unacquainted with the statistical complexities of such a calculation. One reason for expressing the NATO target in these terms was, no doubt, because ministers had been told that Soviet military expenditure had been rising in volume terms by 3 (or 4 or 5) per cent a year for a long period: so the best thing to do was for NATO countries to do the same.

In fact, these figures are anything but clear and unambiguous, as subsequent events and arguments have shown. First of all, there are a number of alternative series for military expenditure—budget figures and outlay figures, figures including or excluding military aid, national figures and standardized NATO figures, and so on. Secondly, it was never clear what base year was to be used for these calculations—and, given that there are some erratic year-to-year movements in military spending, the choice of a base year can make quite a difference. Thirdly, there seems to have been no discussion of the price indices which should be used for the volume calculation. Some countries have a specific price index for the military sector, others do not. There are great problems in constructing a sensible price index for sectors where 'product improvement' is rapid—and the military sector is one such sector.

There is an interesting illustration of this problem in arguments in the UK about the proposed military budget for 1982/83. The Treasury has tentatively put in an 11.4 per cent money increase for 1982/83 over the revised figure for 1981/82, arguing that this allows for 8 per cent inflation and consequently permits a 3.4 per cent volume increase, which meets the 3 per cent target and leaves a margin. The service chiefs complain that the rate of inflation in the defence sector is at least 2 per cent higher than in the economy as a whole, with equipment costs going up by around 14 per cent a year and sometimes more. Then the question arises: how much of this 14 per cent is really a price increase, and how much is the consequence of 'product improvement', and thus should be counted as a volume rise? Even within individual countries, there has been no agreement about the meaning of the target.

In discussing their country's compliance with the NATO target, ministers can pick and choose among a number of different possible military expenditure series and calculations. One of the curiosities of this situation is that, in the discussion of this question, not much use seems to be made of the NATO standardized figures for military expenditure. After all, these figures have been prepared with precisely this purpose in mind—to make comparative statements about NATO countries' military performance which are fair, because the figures are standardized.

Table 5.3 uses these NATO standardized figures to try to answer the question of whether or not NATO countries have accelerated the growth of their military spending since the 3 per cent volume target was adopted. NATO figures are all 'outlay' figures—that is, estimates of actual expenditure, not budget forecasts—and they are all on a calendar year basis. The table, to avoid the problem of erratic base years, uses the average of three

Table 5.3. NATO countries: estimated volume increases in military expenditure

	Per cent increases			
Country	'Pre-target': From 1972–74 average to 1976–78 average	'Post-target': From 1976–78 average to 1981	Latest year: From 1980 to 1981 (estimated)	Size of military spending in relation to USA (USA = 100)[a]
United States	−2.0	3.0	5.9	*100*
Canada	3.9	0.4	1.9	*3*
All NATO Europe	2.3	2.1	1.0	*74*
of which				
FR Germany	1.0	1.7	1.7	*20*
France	3.8	3.0	2.0	*18*
UK	0.3	2.3	−3.6	*16*
Italy	−0.4	4.1	0.5	*6*
Netherlands	3.4	1.3	0.6	*4*
Belgium	5.1	2.3	−0.3	*3*
Turkey	16.0	−1.4	21.1	*2*
Greece	14.4	−2.5	4.1	*2*
Denmark	3.2	1.3	0.8	*1*
Norway	4.1	2.4	1.0	*1*
Portugal	−13.5	2.5	2.4	*1*
Luxembourg	5.8	7.0	4.5	neg

Source: Appendix 5B, table 5B.2.

[a] Based on 1980 military spending figures, at 1979 prices and exchange-rates.

years for this purpose. For producing volume series, consumer price indices are used throughout: some countries have specific indices for the military and others do not. However, with alternative price indices it is most unlikely that the general conclusions which follow would be changed.

The conclusions are fairly straightforward. The United States has turned round the volume of its military spending. It had been falling back from the high Viet Nam peak until 1976; since then it has been rising on an accelerating trend. The 1981 estimated increase is nearly 6 per cent, and present plans call for about an 8 per cent volume increase from now on. How far such a massive increase will in fact be realized is obviously a matter for debate: it is discussed in the US section. However, unless there is a very radical change in policy, there is no doubt that the United States will exceed the 3 per cent target by a wide margin.

The story for other NATO countries is a very different one. For NATO countries in Europe in total, and for Canada, there has been a *deceleration*, not an *acceleration*, in the volume growth of military spending since the target was announced (see table 5.3). In the four pre-target years, military spending in NATO Europe was rising at 2.3 per cent a year; since the target was announced, the figure has come down to 2.1 per cent, and preliminary estimates for 1981 show only a 1 per cent rise. In Canada the change is even more marked; since the target announcement, there has been hardly any rise at all in military spending in real terms. The United States has begun a formidable programme of rearmament. NATO Europe and Canada have not.

There are a number of reasons for these very different patterns of behaviour. In the United States a great many people have felt that the United States' status as a great world power was being challenged—by humiliation in Iran, and by a much increased Soviet threat. Politicians in European countries, on the other hand, did not in general see any radical change in the position in Europe: there did not seem any particular reason to think that the Soviet threat in Europe had suddenly become more acute. Indeed, their reaction to the United States' rearmament programme—an implicit and not, of course, explicit reaction—may well have been that, with the United States accelerating its military spending so much, there was really no need for them to do the same.

West European countries were much more preoccupied with their economic problems—particularly with the problem of inflation, which (rightly or wrongly) was widely attributed to their budget deficits. (Even with the slowing down in the rate of increase in military spending, it has been increasing as a percentage of the 'NATO European' national product —from 3.6 per cent in 1979 to an estimated 3.8 per cent in 1981.)

For those concerned to see a reduction rather than an increase in world military spending, it is a source of some relief that, up to now, the European

NATO countries have not done what they said they would do. There are dangers, however. The US pressure on West European countries to 'carry more of the burden' will undoubtedly intensify: there will be more Senators asking the question 'Why should we defend the Europeans, if they are not willing to defend themselves?' Secondly, we may well see in Western Europe a swing back to Keynesian reflationary policies, and a swing away from preoccupation with budget deficits: we can then expect defence ministers to put forward the argument that rearmament will create jobs (an argument which is already widely used in the discussion of individual weapon programmes).

V. Western Europe

There is a common theme in the story of military expenditure in Western Europe in 1981: a conflict between the rising costs of new weapon systems on the one hand, and a desire to reduce budget deficits on the other. In a number of countries, weapon procurement costs have outrun their budgets, not only for the usual reason of cost overruns, but also for other reasons connected with the general economic recession in the West. The firms producing both civil and military goods have found that the influx of orders for their civil production has been much reduced, so they have completed their military orders on time, or indeed early, and have expected payment. So military expenditures have tended to exceed the budgeted figure. This has come at a time when in a number of countries the reduction of budget deficits has become central to the government's anti-inflationary strategy. Defence ministers and finance ministers have thus come into sharp conflict: in a number of West European countries there have been defence reviews of one kind or another, and weapon programmes have been reduced in an attempt to keep the military budget down.

The United Kingdom

The NATO standardized figures for the UK's military spending show a rather strange year-by-year pattern: a big increase in 1979 (of 4.5 per cent in real terms) followed by an even bigger rise in 1980 (of 8 per cent) and then, on provisional figures, a fall in 1981. A better impression of what is happening is given by grouping the last two years together. After a long period, from 1972 to 1978, in which military spending in the UK was running virtually flat, it is now on a rising trend of the order of 3 per cent a year in real terms.

However, in spite of an explicit decision to change the trend in military spending, the UK has also encountered a sharp conflict between rising weapon costs and budget constraints. In the fiscal year 1980/81, military spending exceeded the initial budget by some £500 million, and there had to be two supplementary estimates. In the fiscal year 1981/82, spending in excess of the original budget of £12.3 billion may be £700 million. In April 1981, the Defence White Paper gave notice of a thorough review of defence spending, one more such review in the very long series of defence reviews in the UK. The main points of the review which emerged in June 1981 can be summarized as follows:

1. The 'independent nuclear deterrent' was sacrosanct.
2. The main cuts were to be made in the Navy's surface fleet.
3. A new general principle was pronounced, that the UK was spending too much money on weapon platforms and too little money on the weapons to go on these platforms.

Although (as ministers constantly point out) the independent nuclear deterrent forms a very small part of the UK's military spending, it is the item in the military budget which has been most discussed. First of all, there has been a very expensive programme of upgrading the warheads on the Polaris missiles; this programme has gone under the label 'Chevaline'. Its total cost was put at about £1 billion in January 1980, when it was thought to be almost completed; since then, significant further expenditure must have been incurred. The main purpose of the programme was to ensure that Polaris missiles would be able to penetrate any further upgrading of Moscow's ABM defences; Moscow is the only city in the Soviet Union which has any ballistic missile defence. The existence of the programme only became known when it had nearly been completed; there was thus no public discussion of its necessity. Apart from the whole question of the value of an independent nuclear deterrent, it is not clear why Moscow itself has to be the target, rather than other Soviet cities which do not have ABM systems. It has been suggested that Chevaline may have been undertaken simply to improve the UK's indigenous capability in warhead construction [12].

The Chevaline programme apparently ran into considerable trouble; in the early tests there were difficulties over the separation process when the warheads and decoys were detached; and a fresh series of tests was started early in 1982. This is not the end of expenditure on the Polaris system. Work has begun, also early in 1982, on replacing the motors in the nuclear missiles. This programme will cost several hundred million pounds spread over a number of years.

The government proposes to replace the Polaris missile system with the US Trident missile system, on a new fleet of submarines. Here a problem has arisen because of the US Administration's decision to press ahead with the Trident II missile. The original British plan was to employ the Trident I missile; however, by the time British submarines are ready, the USA will probably be phasing this missile out, and there would be great difficulties in maintaining in the UK a missile which was no longer in operational use in the United States [13]. The decision to change to a system built on the Trident II missile would have a number of complications. First of all, there would be a significant loss, estimated at £50 million, in 'long-lead orders' which have already been given on the previously existing plans. Secondly, the Trident II is both fatter and longer than the Trident I missile, and the submarines built to carry it would have to be larger—probably at least 15 000–19 000 tons rather than the originally planned 10 000–12 000 tons. Further, both the Trident I and Trident II missiles are weapons of far greater sophistication and accuracy than is needed for a deterrent (rather than a counterforce) weapon. The total cost of replacing the Polaris system may be around £7 billion.

The June Defence Review introduced substantial cuts in the Navy's surface fleet; the Navy's main role is to be an anti-submarine one, and for this purpose there would be greater emphasis on nuclear-powered attack submarines and Nimrod maritime patrol aircraft. Whereas in 1981 there were some 63 ships of frigate size and above in the UK's surface fleet, by 1985–86 that number is to be reduced to 44 [14]. The number of nuclear-powered attack submarines, on the other hand, is to rise from 12 to 17. The Nimrod aircraft would be armed with Sting Ray lightweight anti-submarine torpedoes; and in September it was decided that the contract for a new heavyweight torpedo for the Navy's attack submarines would be awarded to Marconi Space and Defence Systems. This will replace the newly introduced Tigerfish torpedo which is not considered capable of destroying the new deep-diving Alpha-class Soviet submarines with two-layer titanium hulls.

Whereas in FR Germany there has been a great deal of discussion about the Tornado programme, in the UK there has been much less attention paid to it, although it is much more expensive than the cost of replacing the Polaris system. The total cost for the UK of the Tornado programme has now been put at £11 250 million; expenditure on that programme is now reaching a peak in the UK as in FR Germany. Consequently, in agreement with FR Germany, the UK has reduced the peak annual delivery rate of these aircraft from just over 60 to 44, again as part of an attempt to keep military expenditure at or near the budgetary figure. However, the total Tornado programme, which is due to be completed by 1988, has so far remained the same: a total of 385 aircraft for the UK, of which 220 would be the interdiction-strike version (IDS) and 165 the air-defence variant (ADV).

FR Germany

FR Germany has been much more resistant than the United Kingdom to pressures to accelerate its military spending. The rate of increase in recent years has only been of the order of 1.5 per cent a year in real terms: and it is doubtful whether the rise in 1982 will be any greater than that.

In FR Germany discussion of the military budget has been much preoccupied with the costs of the Tornado. This is not surprising, given that the original budget estimate for the Tornado programme in 1981 was DM 1 750 million and a series of upward revisions has brought the figure up to DM 3 065 million [15]. The Tornado programme is proving an immensely expensive one and is leading to cutbacks in weapons procurement elsewhere.

The story of the Tornado—originally referred to as the multi-role combat aircraft (MRCA)—goes back as far as April 1965, when the United Kingdom cancelled its own programme for the TSR-2. The British government then turned to examine the possibility of some collaborative arrangement with France; these negotiations broke down in 1967. The UK then turned to other European countries which had aircraft industries in need of work, and which also had a requirement to replace the F-104 Starfighter. Eventually in 1970 FR Germany, Italy and the UK agreed on a joint programme. The main attraction of the programme was that it would help all three countries to keep an aerospace industry in business, and it would help to maintain some European independence from the USA in the production of military aircraft.

The original unit fly-away price was put in 1970 as DM 15 million: the fly-away price includes costs of production, acceptance flights, and other recurring costs. The original unit system price was DM 28 million; this includes spares, ground and training equipment, armaments transport and packing, and so on. By the end of 1980 these two figures had risen to DM 40 million and DM 70 million, respectively. Part of these rises was of course caused by general inflation; however, when the figures are corrected for the general rate of inflation in FR Germany over the decade, this still leaves an overrun in the unit cost, in real terms, of 50–60 per cent. Furthermore, it seems that the cost of the plane is still rising significantly faster than the general rate of inflation in FR Germany. Various sources suggest that by the end of this year the unit system price may be nearer DM 100 million [16, 17].

FR Germany, like the UK, is faced with a very large total bill for its Tornado programme, although it plans to procure a rather smaller number than the United Kingdom: the West German order is for 324 of the interdiction-strike version. It has agreed with the United Kingdom and Italy to cut back the peak rate of production. Even so, it has had to cut back on the procurement plans of a number of other weapon systems. Ironically one of the programmes that has been cancelled in favour of continued Tornado production is the programme for 200 Roland air-defence missile systems. The Roland units were supposed to protect Tornado and NATO AWACS airfields in FR Germany against low-level attacks. Also cancelled are 2 000 MILAN anti-tank missiles from the Franco–German Euromissile consortium, and research and development on the TKF-90 tactical combat aircraft programme. The planned collaboration with France on a main battle tank for the 1990s to succeed the Leopard and AMX-30, and on the PAH-2 anti-tank helicopter, now seems, if not dead, at least highly uncertain. Among major weapon systems that have been postponed are two additional Type 122 frigates, and Gepard anti-aircraft vehicles.

France

In France, the trend in military spending has been for a rise, in real terms, of over 3 per cent a year over the whole of the past decade. It is a trend which seems likely to continue. Military spending in France appears to be a relatively uncontroversial issue: it was not an issue in the presidential campaign. The French government can take actions in the military field which other European governments would find extremely difficult: thus the new government has announced that France will continue testing neutron weapons and would not rule out their deployment with its national forces. In many other countries, an announcement of this kind would be met with a storm of protest.

The new Administration has made no significant change in the military policy of its predecessors. It is a policy of independence within the Atlantic Alliance; the Defence Minister in the new Administration, M. Charles Hernu, said recently "We must keep our freedom to make decisions, without automatically becoming involved in a conflict against our will" [18].

Thus the policy is not simply to maintain the nuclear deterrent, but to develop it: the new Administration has agreed in principle to go ahead with the construction of a seventh nuclear missile submarine; and the nuclear test programme at Mururoa is to continue. Further, French military policy is not exclusively concerned with Europe. There are agreements with certain African countries which mean that France considers it should have the means for external intervention and should equip itself with this in mind. Thus there is a French Rapid Deployment Force, which has now been increased to some 20 000 men, and has the capability of intervening in the former French colonies in Africa.

Changes are under way in the ownership structure of the French arms industry, as a substantial part of this industry becomes nationalized: for instance, Dassault-Breguet (Mirage aircraft), Matra (missiles) and Thomson-Brandt (defence electronics). It remains to be seen whether this will make any significant difference to the behaviour of these companies.

Three smaller countries

On NATO provisional estimates of military expenditure in 1981, Belgium, Denmark and the Netherlands all had roughly zero growth in military spending (in real terms). In all three countries, the need to hold back public expenditure overrode the commitment to the NATO 3 per cent target. For 1982, the Netherlands government has put a 3 per cent real increase in military spending into its estimates. In Belgium, on the other hand, the 1982 budget would seem to imply a decrease (in real terms). Procurement in particular seems likely to be held back. No funding, for example, is provided for the replacement of the 80 Mirage 5s in the Belgian Air Force, before 1984. In Denmark, the minority government initially proposed a freeze on defence spending in real terms. It came under pressure to change that proposal from NATO in general and from the United States and Norway in particular. As a consequence an agreement was reached with the main opposition parties on a programme which would increase military spending in real terms by 1 per cent in 1982 and 0.5 per cent in both 1983 and 1984.

VI. Japan

Article 9 of the Japanese constitution is part of the necessary background to any discussion of Japanese military expenditure and policy. At the end of World War II, the United States imposed upon Japan a constitution which explicitly forbade the maintenance of military forces. Article 9 reads as follows:

> Aspiring sincerely to an international peace based on justice and order, the Japanese people forever renounce war as a sovereign right of the nation and the threat or use of force as a means of settling international disputes.
>
> In order to accomplish the aim of the preceding paragraph, land, sea and air forces, as well as other war potential, will never be maintained. The right of belligerency of the state will not be recognised. [19a]

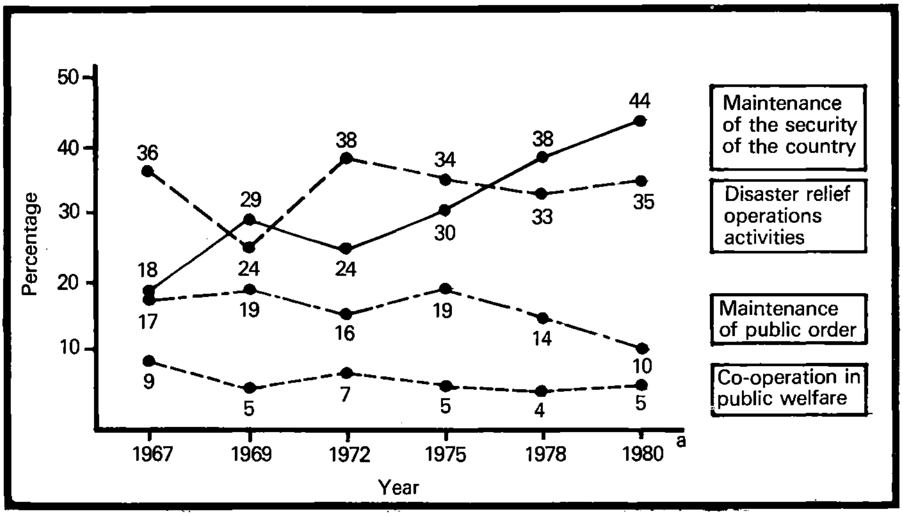
It has obviously been something of a problem to reconcile the gradual reconstruction of Japanese armed forces with this article. One consequence has been a succession of semantic changes. The armed forces were initially called a national police reserve; then they became known as the 'Safety Forces', under a 'National Safety Agency'; finally they have become the Ground Self-Defense Force (GSDF), the Maritime Self-Defense Force

(MSDF), and the Air Self-Defense Force (ASDF), under the Japanese Defense Agency.

However, article 9 of the constitution is still important in the public mind. It might have been expected that, since it was imposed on Japan by an occupying power, there would be strong public opposition to it. In fact, that does not appear to be the case. In a public opinion survey early last year, in answer to the question 'Is it desirable or not to amend Article 9 of the Constitution so that Japan can possess fullfledged armed forces?', 71 per cent replied that it was not desirable. The majority took the view that the Self-Defense Forces were not against the constitution [19b]. However, although most people were in favour of the existence of the Self-Defense Forces, it is only in recent years that their main function was seen as the maintenance of security; in the early 1970s people were more concerned that the Self-Defense Forces should engage in disaster relief operations (figure 5.1). Nor is there any significant public pressure for more military spending: in surveys in the spring of 1981, the majority opinion was that the Self-Defense Forces 'ought to stay at the present level of strength'.

The pressure on Japan to increase its military spending, therefore, does not come from public opinion. It comes mainly from the United States, which has of course long since abandoned its objective of demilitarizing Japan. The United States Administration clearly feels that Japan is a free

Figure 5.1. Japanese public opinion survey: on what should the Japanese Self-Defense Forces concentrate?



[a] The 1980 question was not precisely the same as that of previous years.

Source: Survey by Japanese Prime Minister's Office, quoted in *Defense of Japan 1981*, Japanese Defense Agency.

rider in military matters. Further, in the view of the United States, Japan's low percentage of resources devoted to military uses has helped it to develop a highly competitive civil industry. So Japanese products are reducing the US share of the market both overseas and in the United States itself as well. Thus there is a link between Japan's low military posture and its large trade surplus with the United States.

Under the previous US Administration, the pressure on Japan was simply, in a general way, to spend more on defence. Under the new Administration, there is a more specific suggestion: that Japan, in addition to providing for the self-defence of its own islands, should also defend the airspace and sea lanes up to 1 000 miles from its shoreline [20]. This would obviously require new weapons, such as attack submarines and new aircraft. The suggestion has been met with a cool response in Japan. There may also be some pressure from the large corporations, which are showing some interest in moving into military production in a more substantial way. Thus the chairman of Mitsubishi Corporation, Mr Bunichiro Tanabe, is recently on record as saying, "It is about time the Government lifted the ban on exports of arms to foreign countries" [21].

The long-term trend in Japanese military expenditure, from 1971 to 1979, has been for a real rise which averaged rather more than 4 per cent a year. There was a check in 1980, and then the real rise was resumed in 1981. The budget for 1982 is for a rise of 7.5 per cent in military spending—at a time of zero growth in other categories of government expenditure. This figure does not include any increase in the pay of the armed forces: there will, therefore, be a further real rise this year.

However, the Japanese government will keep to its unwritten rule that military expenditure should not exceed 1 per cent of GNP. Even so, its military spending places it fifth among Western industrial countries.

VII. China

For some time, China has been following a more open policy on publishing material about its military expenditure. The 1981 figure shows an interesting movement. Whereas most other major countries were either increasing, or at least maintaining, their military spending in real terms, in China the military budget for 1981 was cut substantially. The reduction from the 1980 figure was no less than 13 per cent (in current yuan), and the military sector's share of the total national budget fell significantly.

China's assessment of the threat from the Soviet Union is clearly very different from that of NATO in general, or the United States in particular. It has obviously come to the conclusion that there is currently not much risk of a Soviet attack. It is now giving top priority to the improvement of its civil economy. It may also have taken the view that, since a number of other countries are engaged in increasing their military strength *vis-à-vis* the Soviet Union, there is less need, not more, for China to do the same.

Military spending has therefore clearly been given a lower priority in China at the moment. Indeed there are reports that some of China's large weapon production plants (which were originally constructed on the massive scale of Soviet plants of the same kind) are being partially converted to the production of consumer goods.

One consequence of this low priority to military spending in China at the moment is that the US and European firms which had hoped to sell large quantities of military hardware to China are likely to be disappointed. The purchase of foreign military equipment is not high on China's priority list for the expenditure of scarce foreign currency.

The figures in table 5.4 include procurement. The responsibility for the production of weapons rests with the production ministry concerned; most production ministries are responsible for both civil and military production. The Defence Ministry then purchases the weapons from the production ministries. Although procurement is included in the figures, it is probable that the bulk of military research and development expenditure is not included. However, although this exclusion will affect the estimates of the level of military spending, it is unlikely that it alters the trend.

Table 5.4. China's budget figures for military expenditure

Year	Billion yuan
1977	14.9
1978	16.8
1979	20.2[a]
1980	19.4
1981	16.9

[a] The budget figure. Because of the war with Viet Nam, actual expenditure probably exceeded this figure by about 2 billion yuan.

The number in the armed forces is of the order of 4 million men. The higher estimates that have been given—of 4.75 million—probably include the railway, construction and engineering regiments. These, although they still exist as units, have been transferred to civilian control, and are primarily engaged in civil work: for example, the construction of the Peking underground system.

The conversion of the yuan figure into dollars presents the usual problem: what exactly is the meaning of the figure when it has been converted? Indeed, there is little point in attempting a conversion, except in order to provide some kind of estimate for the world total. At the official exchange-rate, China's military expenditure in 1981 (making some allowance for research and development expenditure) would only be of the order of $10.5 billion.

However, the use of the official exchange-rate obviously makes little sense. The conscripts in China's army are paid very little. Conscription is for three years in the army, four years in the air force and five years in the navy. Conscripts have full provision of food, clothing and shelter, and in addition receive 7 yuan a month in the first year, 8 yuan in the second, and 9 yuan in the third. Total expenditure on military personnel in 1981, including food, clothing and shelter, was probably of the order of 5 billion yuan: that is, about 1 250 yuan a year for each member of the armed forces. The comparable figure for the United States is about $16 000 a year. That gives an exchange-rate for military personnel of $13 to the yuan. The cost of a military sector of 4 million persons in the United States would be of the order of $65 billion.

This is, of course, not a sensible figure. Where conscripts cost so little, the military authorities are of course lavish in their use of manpower. The search for a 'correct' dollar figure for the military expenditure of countries such as China, whose military and economic system is wholly different from that of the United States, is a search for a mirage. The only reason for giving a figure at all in appendix table 5B.1 is to provide some kind of estimate of the world total of resources which the military sector uses.

VIII. Some notes on other regions

The Middle East, North and East Africa

In both Egypt and Israel military expenditure (at constant prices) seems to have been coming down, for some years, from the peak period of 1973–77. However, the SIPRI figures of military expenditure include military aid as part of the spending of donor countries, not recipient countries; and now Egypt as well as Israel is receiving US military aid in substantial quantities. In the US fiscal year 1982 (ending on 30 September 1982) Israel will receive $1.4 billion in military aid; Egypt will receive $900 million. This figure for Egypt does not include some $500 million which will be spent on modernizing an air base and supply depot at Ras Banas on the Red Sea [22].

There are no reliable recent figures for the military spending of Iraq and Iran, still engaged in a desultory war. Other Arab states have been giving substantial assistance to Iraq: in April last year Kuwait granted a $2 billion interest-free loan, and there have also been loans from Saudi Arabia and the United Arab Emirates [23].

Military spending in the Middle East is now dominated by the very large figures for Saudi Arabia, which, as a rich country, does not receive military aid but buys its military equipment. However, military spending is also rising fast in some of the smaller states, such as Oman, where it is estimated to have doubled between 1979 and 1981. The flow of military aid from the two great powers to the countries around the Persian Gulf—and to North African countries—is increasing. There are reports of substantial Soviet arms caches in Libya, for example [24]. The United States is using military aid to win access to military facilities near the Persian Gulf, and there is now a formidable programme of US base construction. Oman has indicated that it expects the USA to spend some $1–1.5 billion on military facilities over the next 10 years [25]. Somalia has agreed to provide increased access to its air and port facilities, in exchange for aid. There has also been increased military aid to the Sudan and to Tunisia, and Kenya has agreed to allow US use of Kenyan facilities, notably the port of Mombasa and the airfields of Embakasi and Nanyuki.

South Africa

In South Africa, military expenditure is budgeted to rise sharply. There had been a previous spurt in South Africa's military build-up between 1974 and 1977, set off by Portugal's withdrawal from Angola and Mozambique. The figure then came down temporarily in 1978, partly because of the arms embargo imposed in 1977. Now, in the fiscal year 1981/82 (which runs from 1 April to 31 March), military spending is scheduled to increase by some 30 per cent in money terms, or 15 per cent in real terms (inflation is running currently at about 15 per cent).

So far as military procurement goes, the bulk of the appropriation goes to ARMSCOR, the state-owned Armaments Development Corporation. This Corporation controls directly or indirectly the production of most of South Africa's weapon requirements. South Africa produces (for some items under licence) the French Mirage aircraft, the Italian Aermacchi training aircraft, French-designed Panhard armoured cars, Israeli-designed missile boats, a derivative of the French Crotale surface-to-air missile, air-to-air missiles, artillery pieces, infantry weapons and a wide range of ammunition. In September 1981, the ARMSCOR chairman said that South Africa was now self-sufficient in ammunition; ARMSCOR subsidiaries and contractors manufacture 141 different kinds of ammunition for the army, air force and navy. ARMSCOR claims to be the West's tenth biggest arms producer. However, South Africa is still concerned with the clandestine acquisition of some items of military equipment. Thus it succeeded in acquiring from a Vermont-based production firm, Space Research Corporation, 50 000 155-mm howitzer shells

[26, 27]. This shell is said to be the most advanced product on the market, and to have applications in tactical nuclear warfare. The South African arms industry also appears to have links with Israel, Taiwan and some South American governments.

The army takes over half the defence budget; 80 per cent of all military personnel are in the army. In training exercises, emphasis is laid on counter-insurgency operations, commando strike techniques, and close air support of mobile ground operations. The focus of procurement is towards complete self-sufficiency in items that are being, and will be, needed in sustained, low-level operations.

Now that there is no longer co-operation with Western naval forces, the role of the South African Navy is changing. It no longer considers that it has an anti-submarine warfare (ASW) function to perform on behalf of other nations, and more emphasis is now put on local naval defence, with small strike craft, such as the Israeli-designed missile boats.

India and Pakistan

From 1972 to 1979, military expenditure did not rise much (in real terms) in either India or Pakistan. Since 1979, it has risen quite sharply in both countries. In India, military spending in 1981 is estimated to have been some 8 per cent higher (in real terms) than in 1979. In Pakistan, the rise over the same period was 20 per cent—but on a much smaller total. Further, these figures do not include military aid; and there may well have been arrangements outside the military budgets for the purchase of weapons from the United States and the Soviet Union. To that extent, the military expenditure figures underestimate the size of the increase in resources devoted to the military sector.

Any account of the course of military spending in these two countries is closely tied up with a discussion of the arms trade (chapter 6). In mid-1980 India completed a large arms deal with the Soviet Union, with a nominal interest charge and a 17-year period of repayment; there were also substantial purchases of Jaguar aircraft from the UK and arrangements for their local manufacture.

In Pakistan, the first offer of US aid, in 1980, was turned down because the sum was too small. About a year later, a new and much more substantial aid package was negotiated, for $3.2 billion for five years starting from October 1982; half the money was to be for military purchases. Implicit in the deal is the understanding that it is likely to be cancelled if Pakistan carries out a nuclear explosion. Pakistan is also probably receiving help from 'Islamic friends' to purchase F-16 aircraft before October 1982.

The United States, in giving this military aid, undoubtedly had the northern border of Pakistan in mind. The matter may well be viewed in a different light in India. At the time of writing, however, talks were in progress between Pakistan and India on a non-aggression treaty proposed by Islamabad.

Australia

After a long period of what might be called 'passivity' in military spending, it is now rising quite sharply in Australia (and also in New Zealand). Between 1974 and 1979 there was virtually no change—the rise in Australia was under 1 per cent a year in real terms. In the last two years, the increase has been (again in real terms) over 6 per cent a year.

This is a reaction to the general world situation, rather than to any perceived threat: reaction, that is, to events distant from Australia. Indeed one of the problems of Australian defence policy has been to decide for what range of contingencies to prepare. The policy has been to develop a core force, or core blocks, which could be rapidly expanded if a war breaks out, and also to maintain some knowledge of the state of the art—to include a familiarity with modern high-technology equipment.

However, although the precise contingencies for which preparations should be made might be unclear, there has not been much disagreement over the view that Australia must have the capability to destroy an invading force at sea (or in the air) long before it reaches the country's shores. A good deal of additional procurement, therefore, is going to the navy; in the air force also, the main emphasis is on maritime strike capacity.

IX. Multinational arms production

Technological complexity, high costs and lack of weapon standardization are the main driving forces underlying the growing trend to co-production in the defence sector. This process is mainly a Western affair; WTO weapon inventories are, with a few exceptions, standardized on Soviet equipment. This section concentrates on Western industrialized countries, since arms co-production normally involves these countries. There is, however, also a new tendency towards increasing co-production between industrialized and Third World countries as well as among Third World countries themselves.

The overriding rationale for co-production agreements is related to military efficiency and financial advantage. It is therefore not surprising that the majority of agreements concern combat aircraft and missiles. These weapons are in general more complex and expensive than warships and armoured vehicles. Consequently, larger savings can be made through co-production. The most successful venture so far is the Euromissile consortium set up by Aerospatiale of France and Messerschmitt-Bölkow-Blohm of FR Germany to develop anti-tank missiles and surface-to-air missiles such as HOT, MILAN and Roland. The consortium will also, with the participation of British Aerospace (BAe), develop the new NATO short-range air-to-air missile designated ASRAAM.

Examples of jointly produced aircraft include the Tornado and Jaguar fighters and the Franco-German Alpha Jet trainer. Various plans for a new European aircraft—the ECA and TKF projects—were abandoned in 1981 due to lack of funding and divergent opinions on what type of aircraft is required. Also in 1981, Westland and Augusta signed a second Memorandum of Understanding for joint development of a new ASW helicopter designated EH-101. Turning to warships, it has been estimated that the duplication costs in research and development within the NATO shipbuilding programme equal 20 to 30 new frigates a year [28]. An authoritative observer commented on the state of NATO warship standardization, as follows: "There is no doubt that NATO standardization is a mess ... Minor alleviations have taken place, but national industrial demands have taken precedence over the requirements of the alliance and, in a rapidly advancing technological environment, electronic standardization is chaotic" [29].

The attitude of the United States towards arms co-production has been changing over the last couple of years. The USA has traditionally been very protectionistic in this matter and has also considered European weapon technology to be inferior to its own. Some years ago, however, the RSI-concept was introduced by William Perry, at that time Under Secretary for Defense. RSI stands for rationalization, standardization and interoperability, the broad objectives for achieving greater effectiveness of Western defence through co-operative weapon programmes within NATO. The Reagan Administration is stressing company-to-company agreements aimed at developmental cost sharing, dual production and reciprocal procurement decisions. Examples of this approach during 1981 are: in August, an agreement was signed between McDonnell-Douglas and BAe to produce jointly some 400 AV-8B Harrier V/STOL aircraft for the US Marine Corps and the Royal Air Force; and BAe will also be involved in the production of a new advanced jet trainer for the US Navy and Air Force.

Nevertheless, defence collaboration between the United States and European NATO countries is still in a formative stage. The reason for the slow development of arms co-production seems to be that there is a disadvantage for every advantage. Industrial interests, national interests and alliance interests are seldom coherent and mutual; they tend instead to pull in different directions. From an industrial point of view, the high costs involved in developing and producing weapons demand huge financial resources and large production units. In this respect, the arms industries are subject to the same forces as industries producing civil products, where the trend towards multinational production is well known. Reasons such as these explain the decision by Aermacchi and Aeritalia of Italy and the Brazilian manufacturer EMBRAER jointly to develop and produce the AM-X strike fighter.

On the other hand, many arms industries are unwilling to part with the technology that they have developed. The advantages of avoiding duplication costs through sharing of research and development outlays are often countered with various performance problems when the weapon system is tested. It is also argued that the division of labour in research and development undermines a continued indigenous design capability. Economies of scale cannot be fully exploited in sales to third countries because of different arms export regulations in the countries producing the weapon. Logistic support and repair and maintenance capacity are obviously made easier by standardization, but the complex and often bureaucratic production organization may escalate costs to unacceptable levels. The Tornado programme, for example, with its 500 companies and 70 000 workers in the three participating countries, is so complex that a minor slow-down of work in one country immediately slows down that in the other two countries as well. Finally, arms co-production may require common operational requirements and common tactical concepts. These differ among the NATO allies [30].

In sum, the objectives of RSI meet with problems connected with national security, employment, technology and trade. There is as yet no firm political and multilateral foundation for joint production and procurement of weapons.

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Appendix 5A

An illustration of weapon development: the Maverick and the Condor

Square-bracketed numbers, thus [1], *refer to the list of references on page* 138.

I. Introduction

The purpose of this short study is to take one particular area of weapon development as an illustration of the process. Two air-to-surface missiles—the Maverick and the Condor—have been selected from among the very large number of missiles which have been developed. The study concentrates on the development of one particular component of these missiles—the guidance system. The story of the development of these missiles illustrates a number of aspects of the process: the constant search for product improvement, inter-service rivalry, and the pressure from contractors for the continuation of projects once they are begun.

Certainly, so far as air-to-surface missiles are concerned, a good part of research expenditure has been concentrated on the development of new techniques of guidance. The first method of steering a missile was by radio command. This method was developed in Germany and the United States during World War II, when several missiles came into operation. Towards the end of the 1950s a new generation of radio command missiles, such as the US Bullpup AGM 12A and the French AS.20, came into operation. Bullpup AGM 12A was followed by another five versions (the last one became operational in 1970) and the AS.20 by several other French radio command missiles. Originally the missile had to be steered by keeping it on a sightline to the target using a radio command 'joystick'. This method was successively refined; in some versions the operator was freed from the need to align the target with his sight. Radio command is also a common technique of guidance now in use for Soviet air-to-surface missiles against land and sea targets; these missiles were taken into service from the end of the 1950s [1].

Radar is another method which was developed for steering missiles and is now one of the most widely used means. One mode, called active radar, is that in which the missile sends out a radar beam whose reflection reveals the location of the target; this is a common guidance technique against ship targets, which was first used for the US Bat glide bomb. The first missile equipped with this type of radar was the Swedish RB04, which was put into service in 1958. Other missiles using this mode were deployed during the 1970s. A missile can also be equipped with a radar seeker, to home on enemy radars. This is the passive radar guidance mode. The first anti-radar missile to enter service, the US Shrike, was introduced in 1964 and some versions are still operational. The Shrike was followed by the Standard ARM and the HARM; the HARM is still in development. The Soviet Union has developed the AS-X-9 anti-radar missile [1].

Some of the newest guidance systems now being developed use millimetre-wavelength radar, in particular for missiles directed against armoured targets. Ways have been found of overcoming the disturbance provided by smoke and dust. The seeker works initially as an active radar to search for appropriate targets and lock on to one. As the missile nears its target, 'glint', from multiple reflecting surfaces, could cause guidance problems; the seeker then switches to its passive mode, to home on millimetre-wave energy from the sky that is reflected from the target [2].

Three other methods of guidance are by a television camera fitted to the weapon, by a laser beam, and by infra-red or heat-seeking guidance. These are all examined in more detail in this study in connection with the Maverick and the Condor missiles, for in the process of the development of these missiles all three techniques have been employed.

The method of fitting a TV camera to the weapon to assist in guidance was first tried during World War II by the USA and Germany. Glide bombs equipped with a camera transmitted a TV picture to the aircraft operator, who in turn gave commands back to the bomb by radio. These bombs were thus not 'launch and leave' weapons. Only one bomb became operational (the US GB-4), and it did not work well. At the end of the 1960s the Walleye and the Electro-Optical Glide Bomb (EOGB) became operational. These bombs homed on their own to the target by a TV camera fitted to the nose of the weapon. TV guidance was the method of guidance used in the Condor and the first method used in the Maverick. The latter indeed appears to be the only air-to-surface missile using this form of guidance which has become operational.

Missiles can also be guided by slaving them to a laser beam which is illuminating the target. This method is at present in development for the Maverick as well as for the US Hellfire (an anti-armour missile whose principal launch platform is the helicopter), the Soviet AS-X-10 and the French AS.30L. Finally, there is the infra-red, or heat-seeking guidance technique. This was initially developed particularly with sea targets in mind, because at sea there are fewer problems in discriminating between targets. However, the Imaging Infra-Red (IIR) technique is also being developed for the Maverick for use against both ground and sea targets. It is also being developed for the US Harpoon anti-ship missile, and some foresee this type of guidance also for the French AS.30 missile.

II. The Condor [3]

The great disadvantage of radio command techniques of guidance is that the aircraft has to stay nearby until the missile strikes the target; thus it is vulnerable to enemy defence. The radio command mode has the further disadvantage that it is open to the enemy's electronic countermeasures (ECM). It is obviously preferable to have a type of guidance which is self-homing—that is, without the need to have any data links to the aircraft. The aircraft can then 'fire and forget'. It is free for evasive manoeuvres after launch.

The search for alternative, more satisfactory modes of missile guidance began in the 1960s. There was "an explosion in the technology of tactical weaponry, especially in air-to-surface missiles" [3]. It was not only the US Air Force which began to explore the possibilities of TV guidance: the US Navy did so as well. The Air Force began experimental work with the 'Hornet' programme in 1963 and the development of the Maverick in 1965; the Navy began the development of its Condor missile in the same year. Both were to use TV techniques.

The Navy's original requirement was in some ways similar to that of the Air Force. It was also for a stand-off guided missile to allow pilots to stay clear of enemy defences. However, the Navy wanted a missile with a longer range which would be capable of destroying heavily defended, high-value targets. Its primary purpose was to destroy land targets such as bridges, power stations and dams; the secondary mission was against ships. The Condor's range was usually estimated to be between 60 and 90 km. The contract for the Navy missile was given to Rockwell International.

As early as 1968, the first of many efforts was made to terminate the Condor programme; this first termination proposal came from the Assistant Secretary of Defense for Systems Analysis. There were many other critics in the course of this missile's history—in the House Appropriations Committee, the General Accounting Office, the Office of Management and Budget, and several sectors of the Office of the Secretary of Defense. The burden of the criticism lay in such matters as cost increases, programme delays, and the availability of other, much cheaper weapons, such as the electro-optical glide bomb and the Walleye—both of which could deliver the equivalent of a 900-kg bomb, as against 286 kg for the Condor missile.

The Air Force was constantly offered the Condor missile, and constantly refused it. The Air Force claimed that when slant range was considered, Condor's capability was not adequate to place the aircraft outside the range of hostile surface-to-air missiles. There were also questions about Condor's mid-course guidance by data link—as to whether this was or was not unjammable.

In spite of these criticisms, and in spite of the number of tests and evaluations in which the Condor failed to meet its performance targets, the missile was kept in the Defense budget for a further eight years from 1968. It was, of course, strongly defended by the Navy. Together with the Navy, Rockwell International—in particular, its Missile Marketing Division—lobbied intensively to keep the missile in development and to move it on to the production stage. Rockwell International had good reason to be concerned. It had suffered a prolonged slide in funding from the Department of Defense from the early 1960s to the early 1970s, mainly because it had lost business in the aircraft field and had failed to make gains in missile production. Condor was therefore very important to Rockwell; it was not the prime contractor for any other missile system that was either in production or near that threshold. Rockwell's lobbying included, *inter alia*, entertaining a number of Defense Department and Navy officials concerned with Condor at a hunting lodge in Maryland.

However, by 1976 the estimated unit cost of Condor, which had been put at $70 000 in the early stages of its development, had risen to $415 000 (in 1976 dollars); by 1975 the total estimated programme cost had reached $412 million. Cancellation eventually came in 1976.

III. The Maverick [1, 4–6]

The development of the TV Maverick missile was less troublesome. The initial contract to Hughes Aircraft was for a total package in which development, testing and all the elements that make up a complete operational system are bought together. Hughes Aircraft claims that Maverick is the only weapon system developed under the total package arrangement which did not overrun in cost. Development started in 1965. The first fully guided flight was made in 1969 and the first version of the missile, designated AGM 65A, was operationally deployed in 1973. The success of this missile has led to a series of further versions, designated AGM 65, versions B to F; their characteristics are summarized in table 5A.1 and they are described below.

In these further developments, the main changes have been in the guidance system. Other parts of the missile have remained much the same. The airframe in all versions is 2.46 m long, with a diameter of 0.30 m. The engine for the AGM 65A–D is the Thiokol TX-481 with dual thrust using a solid propellant and giving a speed greater than Mach 1. The E and F versions use a new propulsion unit which is only a modification of this engine with a new smokeless propellant. The weight depends on the

Table 5A.1. The Maverick missile: characteristics of successive versions

Designation	Military service	Guidance	Weight (kg)	Warhead	Weight of warhead (kg)	Status	Year of operational deployment
AGM 65A	AF	TV	210	Conical-shaped charge	59	Operational	1973
AGM 65B	AF	TV scene magnification	210	Conical-shaped charge	59	Operational	1976
AGM 65C	AF, MC	Laser	210	Conical-shaped charge	59	Cancelled	–
AGM 65D	AF	Imaging infra-red	210	Conical-shaped charge	59	In development	1983 (est.)
AGM 65E	MC	Laser	286	Blast/fragmentation	135	In development	1983 (est.)
AGM 65F	N	Imaging infra-red	286	Blast/fragmentation	135	In development	1984 (est.)

AF = Air Force, MC = Marine Corps, N = Navy
Conical-shaped charge warhead = a warhead whose forward face has the form of a deep re-entrant cone; upon exploding, this directs a jet of gas and vaporized metal forward at such a speed that it penetrates thick armour.
Blast/fragmentation warhead = a warhead which relies on both blast and the fragments of a thick-walled casing or rod.

Source: References [1, 4–6].

warhead, which is either a conical-shaped charge or a blast/fragmentation warhead.

The Maverick is launched from rail launchers underneath the aircraft's wings in clusters of three or singly. It is operational on many types of aircraft, including the F-4, A-10, F-5, A-7 and the AJ37 Viggen. It is also intended for use on several other types.

The 'flight mechanical' range is given by the propulsion system and is almost the same for all versions. This range depends very much on the launch speed and altitude. For a low-level launch the range is estimated at 10–15 km. Launches from high altitude (10 000 m) will give ranges up to 40–50 km.

The *actual* range depends on the possibility of acquiring the target and locking on to it; this means that target size and scenario have a significant influence, as does the aircraft target acquisition system. For example, a tank in open terrain can be acquired at about 5 km with the A version and at about double that range with the B version. The C to F versions are more likely to use different acquisition systems in the aircraft, which means still longer detection ranges [7].

Maverick has many roles. Apart from the air-to-ground role, it can also be used against ships. In its ground attack role it is intended for use against small hard targets such as tanks, armoured vehicles, field fortifications, gun positions, concrete communications centres and aircraft shelters.

IV. TV-guided Maverick (AGM 65A and B)

The TV-guided Maverick works in the following way. While still attached to the underwing rail launchers, the Maverick through its nose-camera presents a view of what it sees to the pilot on a TV screen in the cockpit. The pilot locates the target on the display, moves the missile camera so that the fixed set of cross-hairs lies over the target, gives the lock-on command and launches the missile. The missile continues to the target on its own, guided by the target image keeping the lock-on gate on the target until impact. The pilot is free to veer away or attack other targets.

The Air Force thus acquired a weapon which increased the survivability of the aircraft (compared to missiles guided by radio command) by reducing the time spent in an exposed position. It also eliminated the threat of ECM interference. However, this missile could only be used during daytime and in good weather conditions. This also meant that the missile was vulnerable to such countermeasures as smoke.

Compared to the TV-guided glide bombs—the EOGB and the Walleye—the Maverick missile has the advantage that for any given range it can be launched from a lower altitude; the aircraft will thus be less exposed to an enemy radar.

In all, 13 000 rounds of the AGM 65A were produced for the USAF until production stopped in 1976. Another 6 000 rounds were produced for export. The missile has been sold to Egypt, Greece, Iran, Israel, Saudi Arabia, South Korea, Sweden and Turkey. As a result of the Swedish government's decision to buy the Maverick, the Swedish RB05B was discontinued in 1977. Israel, after its purchase of the Maverick, probably discontinued development of its own TV-guided missile, the Luz.

The next version of the Maverick—the AGM 65B—was developed during the 1970s and operationally deployed in 1976. It works in the same fashion as the AGM 65A: the pilot acquires the target visually through a TV picture presented on a display in the aircraft. The missile is locked on to the target before release and homes on to it without command from the aircraft.

The essential difference between the A and the B versions is the introduction in the B version of the scene magnification seeker. The field of vision was diminished from 5° to 2.5°, and at the same time the TV picture of the target was considerably magnified. This means that the range was increased (some estimates say it was doubled), or that much smaller targets could be attacked. The increased range in its turn increases the chance of survival of the aircraft.

Around 7 000 AGM 65Bs were initially produced. None of the initial production was exported. However, foreign military sales of the A version led to an increased demand for the B version to replenish home inventories [8]. In 1981 the production line was reopened to fulfil some overseas orders for the AGM 65B. Switzerland and Singapore have requested permission to buy this version. Some small changes have been made: the propellant is now near-smokeless, which of course increases the difficulty for ground-to-air defences.

Hughes Aircraft claims considerable operational accuracy for the Maverick AGM 65A and B versions. However, it has been argued that tests have not been carried out under realistic conditions. Opinions also differ on whether the missile failed or was successful when used in Viet Nam. The development costs of the AGM 65A and B were $144.7 million [9]. The average unit historical costs of the two versions (excluding those produced from the re-opened production line in 1981) came to $16 000 per missile [10]. The current cost, at 1981 prices, is of the order of $50 000 per missile [11]. These are the unit costs of one completely equipped missile. No spares are included. The price at which the missile is sold is higher.

V. The laser Maverick (AGM 65C and E)

The disadvantage of the TV-guided system is that it can only operate in daylight and in good weather. The next stage in the development of guidance systems for the Maverick missile was to look for methods which avoided these disadvantages. The use of a laser beam was one such method.

The first flight of a missile with laser guidance was made in 1965. In 1968, Paveway bombs, using a laser, became operational and were used in Viet Nam. Then between 1969 and 1971 the Marine Corps sponsored the development of a laser-guided missile, the Bulldog.

A laser-seeking system means that the missile is equipped with a laser seeker which homes on to an illuminated spot. This spot is imposed on the target by a laser designating device. This designator can be installed in the missile-carrying aircraft itself or in another aircraft nearby, or it can be held by a person on the ground close to the target. The Marine Corps proposes to use the last of these three methods, with a soldier on the ground designating a target which he wants destroyed; the laser-guided missile fired from the aircraft would then home on to that target, with the aircraft pilot possibly not knowing what the target was.

The laser Maverick is superior to the TV Maverick in several respects. Apart from its day/night capability, it is also to be preferred when attacking low-contrast and unbounded targets (i.e., targets lacking well-defined visual contrast features). Laser countermeasures such as smoke, while a problem, are operationally impractical to use in a battlefield environment where the missile would be employed [12a].

The development of a laser-guided missile in the United States was complicated by the competition between the Air Force's Maverick missile and the Marine Corps's Bulldog. In 1971 the Air Force was given the task of developing a laser seeker which could be used by all three services—the Army, the Marine Corps and the Air Force. It was to be used on the Army's helicopter-launched anti-armour missile, the Hellfire, on the GBU 15 glide bomb, and on a missile which was to be common between the Air Force and the Marine Corps [13].

The decision on the common missile was preceded by arguments from the Air Force and the Marine Corps in favour of their respective missiles. The Marine Corps claimed that the Bulldog would have a unit programme cost of around $21 000 while the seeker of the Maverick alone would cost $28 750 per copy. The Air Force stated that their Maverick seeker would cost only $5 000 and the whole missile $13 500 [14]. The decision went in favour of the Maverick, and in 1974 the Bulldog programme was cancelled. However, during the long period in which the laser Maverick was being developed, the Defense Department did from time to time reconsider the Bulldog as an interim measure for the Marine Corps.

In the course of development of the laser-guided missile, problems arose particularly with the aircraft designator, and in any case the Air Force became more interested in the imaging infra-red guidance system. In 1979 the Air Force withdrew its demand for a laser-guided missile, leaving the Marine Corps as the sole customer. Since the Marine Corps intended in any case to use a ground-based laser designator, it was not particularly concerned with the fact that there were difficulties with aircraft designation. The description of the laser-guided version of the Maverick was then changed from AGM 65C to AGM 65E (see table 5A.1). The Marine Corps wished to have the heavier blast/fragmentation warhead, since it intended to use it against targets requiring these larger warheads.

The laser Maverick has become an expensive missile for the Marine Corps. Whereas the development costs for the Bulldog were only $16 million [12b], they were $65.3 million for the laser Maverick [9]; these costs, now that the Marine Corps is the sole customer, are to be spread over a fairly small number of missiles. The Corps has requested 4 600 missiles. The missile should become operational in 1983.

The common tri-service laser seeker, which the Air Force had been given the task of developing in 1971, has not as yet materialized. The GBU-15 glide bomb laser-seeker programme is terminated, and the Hellfire missile development continued with a seeker which the Army claimed was less expensive. However, that claim is now being questioned, and the Senate Armed Services Committee has requested the Secretary of Defense to "assess the possibility of using the Maverick Tri-Service seeker on the Laser Hellfire" [15].

VI. The IIR guidance Maverick (AGM 65D and F)

From the Air Force's point of view, the laser Maverick had a number of disadvantages. It was not a 'launch and leave' weapon, the aircraft designator tests had been unsatisfactory, and, although the laser system could cope with 'normal' rain, it could not cope with fog or smoke. The Air Force therefore concentrated its efforts on development of the imaging infra-red guidance system.

The infra-red seeker forms a TV-like picture by sensing the difference in infra-red heat radiated by objects in view. It has many clear advantages over the TV and laser versions. It is a 'launch and leave' weapon, it has been claimed to have up to three times the lock-on, tracking and launch-range of the TV Maverick, and it is an adverse-weather, night or day system. It can penetrate battlefield smoke and dust. It can be used against hidden or camouflaged targets and can distinguish decoys by their low temperature. However, it cannot be used in heavy fog or heavy rain, since the humidity would absorb the infra-red heat.

The infra-red seeker is also more sensitive than the laser seeker. However, when the centre of a target is not the best place to hit, an IIR missile can be used together with a laser spot tracker to guide the missile to the most vulnerable spot, which is then illuminated by a laser designator.

The development of the IIR seeker began as early as 1970, but it was not until 1974 that it reached the advanced development stage. In 1976 Congress denied further funding, because it was doubtful whether such a development would be cost effective. The programme was reinstated in 1977, and in that year Hughes Aircraft was awarded a contract to define a common IIR seeker assembly for the GBU-15 glide bomb and the Walleye II guided bomb as well as the Maverick [16].

The AGM 65D (see table 5A.1) will be procured by the Air Force and is expected to enter service in 1983 [17]. The normal review which precedes a full-scale production decision has been set aside for this missile, as it has for other high-priority programmes. The Air Force plans to procure 60 000 rounds of this missile. The Navy is proposing to procure a slightly different version, the AGM 65F. In this version the tracker's software is specially programmed for ship attack, and this model is fitted with the blast/fragmentation warhead. The fuse delay can be selected to allow the air crew to choose the best setting for detonation inside the target ship. The Navy plans to buy 7 000 of the AGM 65F, to be delivered by mid-1984 [18].

The development costs of the IIR Maverick have amounted to $185 million up to the end of FY 1981 [9]. The unit cost of AGM 65D and F is estimated at $75 000, in 1983 dollars.

All three versions of the Maverick missile are therefore going into production. Hughes Aircraft is preparing to produce around 200 a month of the TV version, between 100 and 200 a month of the laser version, and 500 a month of the IIR version.

VII. Conclusions

This short study of the Maverick missile illustrates some aspects of the process of weapon development. It illustrates, for example, the long lead-times in this process. The development of the IIR seeker began in 1970; however, an air-to-surface missile equipped with such a seeker will not enter the inventory until 1983.

The process of development of the guidance system for air-to-surface missiles had two main objectives. One was for a 'launch and leave' capability, from as great a range as possible, so that a missile could be fired from a position beyond the defensive capability of the target and so that the aircraft could then immediately leave the scene after firing the missile. The second main objective was for an all-weather day and night system. The TV Maverick was a 'launch and leave' missile. Whether, however, it could be fired from a position beyond the defensive capability of the target would depend partly on how that target was defended. Further, it was only a daylight/fair-weather missile.

The laser-guided version had the advantage over the TV version that it could be operated at night and in light or 'normal' rain. However, it had to have a laser designator. As at present envisaged, it will be a system by which a soldier on the ground can call in an air strike on a target which he has designated.

The IIR version has the advantage over TV Maverick both in range and in the fact that it can be operated both by day and night and also in poor weather. Its use can be combined with terminal laser guidance, to direct it to a particular spot on the target. It is also a 'launch and leave' missile. So the process of development, perhaps at a total cost of the order of $500 million, has brought the air-to-surface missile much nearer to the objectives originally set.

The account of the development of Maverick also illustrates another theme common to weapon development: inter-service rivalry and the opposite trend to a search for commonality in weapons between the three services. The Navy persisted with the development of the Condor missile long after the evidence suggested that it could not be cost effective. There was an attempt to get a tri-service laser seeker which could be used on weapons deployed by all three services. The attempt appears so far to have been unsuccessful. On the other hand, there does seem to have been some success in developing an IIR seeker which is common to more than one of these services, and there is also now the common Air Force–Navy programme in the development of the IIR Maverick missile.

Postscript

On 23 February 1982, the Pentagon announced that it will hold up full-scale production of the IIR (AGM 65D) Maverick missile until technical problems are ironed out, leading to a delay in the programme. It appears that some of the missile's components, including the seeker, have failed in testing. Recent tests have shown problems in identifying the target: a sun-heated rock could be taken to be an enemy tank.

There have also been suggestions that earlier tests of the IIR Maverick have been unrealistic. The target tanks moved in a way that the pilots could predict. Even under these conditions, the test results were not impressive. However, a spokesman for the United States Air Force stated that the IIR Maverick is still a high-priority item in their weapon procurement list [19].

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Appendix 5B

World military expenditure, 1972–81

For the sources and methods for the world military expenditure data, see appendix 5C. For the conventions used in the tables and for footnotes, see page 153.

Table 5B.1. World military expenditure summary, in constant price figures

Figures are in US $ mn, at 1979 prices and 1979 exchange-rates. Totals may not add up due to rounding.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
USA	134 794	127 972	126 514	122 688	116 045	120 805	121 595	122 279	126 865	134 390
Other NATO	81 684	83 174	85 753	87 837	89 672	91 204	94 393	96 282	98 546	99 567
Total NATO	216 478	211 146	212 267	210 525	205 717	212 009	215 988	218 561	225 411	233 957
USSR	[103 900]	[105 600]	[107 300]	[109 000]	[110 400]	[112 100]	[113 700]	[115 200]	[116 900]	[118 800]
Other WTO	8 993	9 420	9 869	10 612	11 061	11 461	11 798	11 985	12 100	[12 795]
Total WTO	[112 893]	[115 020]	[117 169]	[119 612]	[121 461]	[123 561]	[125 498]	[127 185]	[129 000]	[131 595]
Other Europe	10 872	11 101	11 883	12 404	13 012	12 962	13 079	13 612	13 754	(13 627)
Middle East	12 320	17 249	24 909	30 784	34 037	33 043	33 432	(34 918)	(36 396)	[43 950]
South Asia	4 601	4 154	3 969	4 356	4 931	4 774	4 969	5 037	[5 480]	[5 587]
Far East (excl. China)	14 795	15 800	16 010	18 167	20 133	21 547	23 811	24 569	25 088	26 654
China	[29 000]	[30 700]	[30 700]	[32 400]	[33 200]	[32 300]	[37 000]	[44 400]	[42 700]	[37 200]
Oceania	2 995	3 074	3 326	3 429	3 417	3 430	3 428	3 446	3 617	3 906
Africa (excl. Egypt)	6 519	6 795	8 525	(10 219)	(11 250)	(11 358)	(11 468)	[11 690]	[12 450]	[13 600]
Central America	1 094	1 152	1 226	1 366	1 647	1 950	2 085	2 158	2 134	2 299
South America	4 737	4 854	5 645	5 159	7 240	7 193	7 249	7 351	[6 512]	[6 352]
World total	**416 304**	**421 045**	**435 629**	**448 421**	**456 045**	**464 127**	**478 007**	**492 927**	**502 542**	**518 727**
Developed market economies[a]	238 596	235 134	236 807	236 498	232 980	239 751	244 031	247 718	253 541	262 137
Centrally planned economies[a]	[143 805]	[147 633]	[150 204]	[154 759]	[157 869]	[159 407]	[166 415]	[175 844]	[176 125]	[173 652]
OPEC countries[a]	11 127	13 833	22 381	29 190	32 934	31 824	33 534	(34 120)	(37 400)	[46 220]
Non-oil developing countries:[a]										
with (1978) GNP *per capita* < US $300	6 333	5 642	5 632	(5 957)	(6 390)	(6 050)	(6 576)	[6 740]	[7 284]	[7 687]
with (1978) GNP *per capita* US $300–$699	4 695	6 539	7 182	7 850	8 002	8 703	7 306	(7 008)	(6 850)	[7 090]
with (1978) GNP *per capita* > US $699	10 825	11 282	12 429	13 037	16 620	17 053	(18 669)	(19 970)	(19 782)	(20 284)
Total non-oil developing countries	21 853	23 463	25 243	26 844	31 012	31 806	32 551	33 718	33 916	35 061
Southern Africa[a]	1 326	1 508	1 975	2 407	2 815	3 190	3 305	3 260	[3 170]	..

Table 5B.2. World military expenditure, in constant price figures

Figures are in US $ mn, at 1979 prices and 1979 exchange-rates. Totals may not add up due to rounding.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
NATO										
North America:										
Canada	3 485	3 483	3 736	3 686	3 935	4 187	4 344	4 119	4 150	4 227
USA	134 794	127 972	126 514	122 688	116 045	120 805	121 595	122 279	126 865	134 390
Europe:										
Belgium	2 671	2 794	2 833	3 085	3 245	3 331	3 551	3 631	3 701	3 690
Denmark	1 298	1 234	1 351	1 466	1 447	1 454	1 510	1 518	1 533	(1 546)
France	17 640	18 286	18 206	19 015	19 842	20 942	22 162	22 667	23 160	23 633
FR Germany	21 955	22 816	23 814	23 707	23 535	23 444	24 421	24 777	25 081	25 509
Greece	1 285	1 321	1 641	2 110	2 310	2 449	2 502	2 424	2 097	2 184
Italy	7 063	7 053	7 061	6 571	6 539	7 020	7 320	7 784	8 145	8 184
Luxembourg	28.7	31.4	33.9	36.0	38.6	37.8	41.2	42.4	49.2	51.4
Netherlands	3 998	4 062	4 250	4 457	4 409	4 915	4 752	5 037	4 902	4 931
Norway	1 133	1 142	1 172	1 271	1 303	1 328	1 419	1 453	1 469	1 484
Portugal	1 248	1 153	1 381	950	743	684	692	701	761	779
Turkey[e]	1 886	2 025	2 122	3 340	3 837	3 694	3 381	3 001	2 842	3 442
UK	17 987	17 769	18 145	18 136	18 482	17 712	18 291	19 121	20 649	19 901
Total NATO (excl. USA)	81 684	83 174	85 753	87 837	89 672	91 204	94 393	96 282	98 546	99 567
Total NATO	216 478	211 146	212 267	210 525	205 717	212 009	215 988	218 561	225 411	233 957
WTO										
Bulgaria	474	512	580	658	716	777	810	(869)	(922)	(964)
Czechoslovakia	1 960	2 060	2 108	2 304	2 333	2 280	2 368	(2 379)	(2 552)	. .
German DR	2 583	2 758	2 861	3 034	3 229	3 371	3 540	(3 718)	(4 030)	(4 369)
Hungary	646	629	688	741	698	725	824	778	753	(810)
Poland	2 280	2 395	2 454	2 578	2 675	2 860	2 738	(2 722)	(2 522)	. .
Romania	1 047	1 064	1 175	1 293	1 408	1 446	1 515	1 517	(1 318)	(1 285)
USSR	[103 900]	[105 600]	[107 300]	[109 000]	[110 400]	[112 100]	[113 700]	[115 200]	[116 900]	[118 800]
Total WTO (excl. USSR)	8 993	9 420	9 869	10 612	11 061	11 461	11 798	11 985	12 100	[12 795]
Total WTO	[112 893]	[115 020]	[117 169]	[119 612]	[121 461]	[123 561]	[125 498]	[127 185]	[129 000]	[131 595]
Other Europe										
Albania[b]	81.4	81.4	84.1	87.6	108	111	113	115	126	. .
Austria	569	575	647	722	739	764	834	863	873	847
Finland	494	503	518	557	567	525	550	615	600	632
Ireland	130	149	148	195	203	209	220	241	249	. .

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Spain	2 465	2 696	2 927	3 047	3 263	3 272	3 256	3 417	(3 576)	(3 682)
Sweden	3 178	3 189	3 215	3 305	3 299	3 315	3 368	3 493	3 327	3 157
Switzerland	2 003	1 940	1 933	1 823	2 066	1 951	1 962	2 053	2 041	2 000
Yugoslavia	1 947	1 967	2 408	2 663	2 762	2 812	2 771	(2 812)	(2 958)	(2 936)
Total Other Europe	10 872	11 101	11 883	12 404	13 012	12 962	13 079	13 612	13 754	[13 627]
Middle East										
Bahrain	36.3	37.5	48.4	26.0	34.0	44.4	108	141	149	[115]
Cyprus	18.9	17.5	25.0	26.6	26.0	34.5	27.5	35.5	(25.8)	(18.8)
Egypt	1 788	3 297	3 642	3 536	3 074	3 218	[2 041]	[1 714]	[1 539]	. .
Iran	2 891	3 982	8 801	11 230	12 178	9 867	9 165	[5 080]	[4 040]	. .
Iraq[f]	909	1 123	2 210	2 247	2 204	2 303	2 179	2 675	. .	. .
Israel[e]	2 531	(3 577)	(3 632)	(3 868)	(3 866)	(3 862)	(3 437)	(3 540)	[2 462]	. .
Jordan[f]	340	328	297	294	479	383	362	433	(404)	(420)
Kuwait[f]	388	414	758	904	1 113	1 244	1 122	[1 067]	[1 679]	. .
Lebanon[b]	65.7	76.2	92.5	97.1	100	78.6	151	227	282	325
Oman[b]	72.4	121	341	697	784	686	767	778	1 178	1 444
Saudi Arabia	2 700	3 447	(4 248)	(6 497)	(8 747)	(9 447)	[11 717]	[15 587]	[18 474]	[22 458]
Syria	446	691	652	1 167	1 160	1 161	1 218	2 110	1 801	. .
United Arab Emirates[b]	. .	13.5	20.9	32.5	81.8	505	791	1 151	(1 179)	. .
Yemen Arab Republic[d]	74.0	71.6	87.6	102	126	140	258	. .	. .	. .
Yemen, People's Democratic Rep. of[f]	55.3	49.5	49.9	55.2	59.1	65.7	84.0	105	. .	. .
Total Middle East	12 320	17 249	24 909	30 784	34 037	33 043	33 432	(34 918)	(36 396)	[43 950]
South Asia										
Afghanistan	[47.5]	51.8	48.7	53.6	68.1	69.5	74.1	. .	. .	. .
Bangladesh	. .	49.1	57.5	74.5	127	136	122	127	134	140
India	3 455	3 029	2 839	3 195	3 695	3 508	3 654	3 690	(3 988)	(3 991)
Nepal	9.7	10.0	10.1	11.5	15.0	15.6	15.9	(22.6)	(27.7)	. .
Pakistan	1 070	1 000	998	1 003	1 006	1 025	1 081	1 095	1 212	1 307
Sri Lanka	18.3	13.1	16.0	16.9	[19.8]	[17.9]	[22.0]	[26.4]	34.7	. .
Total South Asia	4 601	4 154	3 969	4 356	4 931	4 774	4 969	5 037	[5 480]	[5 587]
Far East										
Brunei	25.3	27.7	32.3	58.7	93.7	86.4	146	171	123	. .
Burma	240	217	185	160	[162]	[182]	199	. .	. .	. .
Hong Kong	43.7	34.6	30.1	29.7	53.8	82.2	118	(98.1)	(100)	196
Indonesia	[952]	[1 221]	[1 333]	[1 659]	[1 663]	1 608	1 729	1 650	1 261	1 426

Japan	6 920	7 267	6 830	7 352	7 773	8 077	8 737	9 337	9 276	9 461
Korea, North	1 428	1 418	1 771	2 120	2 341	(2 410)	2 667	2 915	3 128	3 424
Korea, South	1 108	1 120	1 428	1 652	2 373	2 819	3 515	3 300	3 477	3 519
Malaysia	560	592	615	701	634	753	801	826	1 242	(1 639)
Mongolia[b]	(65.5)	(72.7)	(123)	(127)	(138)	(138)	(143)	(163)	(145)	(238)
Philippines	279	556	(629)	(756)	863	853	783	631	[653]	688
Singapore[f]	384	352	338	395	479	502	522	529	521	556
Taiwan	1 301	1 403	1 197	1 343	1 565	[1 864]	[2 123]	2 240	2 439	2 456
Thailand	564	531	499	679	738	828	842	972	949	1 036
Total Far East (excl. Kampuchea, Laos and Viet Nam)	13 876	14 818	15 015	17 038	18 882	20 208	22 331	23 042	23 529	24 998
Total Far East	14 795	15 800	16 010	18 167	20 133	21 547	23 811	24 569	25 088	26 654
Oceania										
Australia	2 687	2 767	3 004	3 102	3 103	3 111	3 091	3 100	3 245	3 508
Fiji	1.4	1.5	1.5	2.0	2.9	3.1	3.5	3.7	5.0	3.8
New Zealand	306	305	319	325	311	315	334	341	367	393
Total Oceania	2 995	3 074	3 326	3 429	3 417	3 430	3 428	3 446	3 617	3 906
Africa										
Algeria	246	255	489	543	761	664	719	601	..	..
Benin[b]	8.9	6.5	7.3	7.9	8.3	(12.6)	..	..	..	..
Burundi	13.0	13.6	15.0	14.4	17.3	23.6	23.3	(17.8)	..	..
Cameroon	65.5	66.7	67.2	71.2	74.9	71.9	68.6	69.9	75.1	81.9
Central African Republic	12.4	14.4	13.6	12.5	12.2	10.8	11.8	14.4	11.3	..
Chad[d]	28.6	25.0	23.3	22.2	31.7	(36.0)	(41.3)	..	..	..
Congo	28.2	36.8	46.8	49.3	52.6	50.4	43.7	52.7	..	..
Equatorial Guinea[b]	[3.8]	[3.9]	[4.0]	[4.0]	..	..	..	..	..	..
Ethiopia	115	113	158	248	198	179	290	348	[427]	..
Gabon	19.7	23.3	25.2	27.8	30.8	39.9	(61.7)	56.6	66.1	..
Ghana[e]	237	241	314	297	265	152	113	(123)	[98.1]	..
Guinea[b]	[38.1]	[39.1]	[39.3]	..	..	..	..	..	..	..
Ivory Coast	(70.7)	(74.0)	97.6	87.0	82.5	(80.5)	108	102	102	..
Kenya	67.8	76.8	82.5	83.0	119	199	261	245	(192)	(183)
Liberia	8.3	6.7	5.7	6.0	6.9	8.7	9.8	12.8	..	..
Libya	(520)	(625)	(1 135)	(1 135)	(1 860)	(1 880)	(2 305)	..	..	..
Madagascar	35.2	37.0	41.7	40.0	50.1	61.3	63.1	81.9	..	70.6
Malawi	3.4	5.1	6.1	11.9	12.5	18.0	24.2	22.2	..	..
Mali	23.8	21.4	24.0	32.9	39.2	38.3	31.7	36.0	..	..

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Mauritania	8.7	10.5	12.2	38.6	(55.5)	(72.1)	84.2	70.6	. .	. .
Mauritius	1.2	1.2	1.2	1.6	1.9	1.8	1.9	. .	. .	. .
Morocco	312	360	424	623	875	1 004	892	896	(999)	(1 005)
Mozambique[b]	. .	. .	. .	12.0	(35.2)	38.0	72.9	74.6	. .	111
Niger	8.4	7.7	8.7	11.5	11.4	. .	. .	. .	. .	. .
Nigeria	1 805	1 987	2 185	3 265	2 786	2 662	2 095	1 845	1 869	. .
Rwanda	16.4	22.2	16.4	14.8	16.4	15.9	17.1	17.6	. .	. .
Senegal	48.1	48.0	53.7	49.5	59.1	59.0	65.1	63.3	58.7	63.2
Sierra Leone	7.8	9.0	9.6	9.4	8.7	12.7	[13.7]	. .	. .	. .
Somalia	37.9	39.0	44.1	39.7	39.6	43.4	83.3	94.0	. .	. .
South Africa	830	1 015	1 360	1 670	2 066	2 336	2 250	2 153	2 108	2 254
Sudan	296	261	210	174	221	251	(237)	[326]	. .	. .
Tanzania	83.6	108	141	133	140	173	320	[296]	. .	. .
Togo	10.2	11.7	13.1	13.6	19.6	20.9	24.2	(22.6)	20.5	. .
Tunisia	56.6	57.6	69.8	95.1	107	145	163	153	172	214
Uganda[d,e]	566	409	315	314	279	193	140	. .	. .	. .
Upper Volta	12.1	12.2	12.5	27.0	35.5	32.9	39.5	32.0	. .	. .
Zaire[e]	454	363	576	390	(239)	(53.6)	(44.2)	(115)	. .	. .
Zambia	305	246	303	401	328	314	[285]	[295]	[259]	. .
Zimbabwe	107	139	170	191	244	328	377	441	[431]	. .
Total Africa	6 519	6 795	8 525	(10 219)	(11 250)	(11 358)	(11 468)	[11 690]	[12 450]	[13 600]
Central America										
Costa Rica[f]	10.8	11.9	12.3	14.8	19.4	21.3	24.1	(21.0)	20.9	19.0
Cuba[c,f]	337	341	356	(412)	. .	886	992	1 064	1 026	1 065
Dominican Republic	70.5	65.2	74.9	78.7	86.0	85.7	95.1	158	93.4	. .
El Salvador[f]	29.1	45.0	48.8	43.8	55.7	65.8	68.4	(68.0)	61.1	85.9
Guatemala	50.6	42.5	46.5	64.4	67.2	93.5	81.6	84.6	. .	. .
Haiti	16.1	13.4	12.4	12.8	13.1	13.4	16.6	. .	. .	. .
Honduras	25.5	25.2	23.5	28.0	29.6	29.0	34.1	. .	. .	. .
Jamaica	14.9	23.2	21.8	24.1	29.2	27.8	. .	. .	. .	. .
Mexico	472	527	562	612	641	625	633	565	704	782
Nicaragua	42.8	33.6	43.1	48.1	59.4	. .	. .	. .	27.1	. .
Panama	15.0	16.1	16.8	18.0	(18.0)	. .	. .	. .	. .	. .
Trinidad and Tobago	8.5	6.8	7.2	8.5	9.4	10.2	. .	. .	. .	. .
Total Central America	1 094	1 152	1 226	1 366	1 647	1 950	2 085	2 158	2 134	2 299

South America										
Argentina[e]	1 600	1 248	1 471	[814]	2 702	2 255	2 339	2 641	2 126	2 241
Bolivia	45.9	53.7	62.2	84.7	92.8	89.1	96.1	91.5	86.3	. .
Brazil[e]	1 496	1 778	1 806	1 799	2 149	2 033	2 089	1 785	1 265	1 234
Chile[e]	225	360	627	489	487	566	713	951	[1 128]	[949]
Colombia	229	209	200	222	228	209	192	(211)	264	236
Ecuador	92.4	110	127	155	142	236	180	185	182	165
Guyana[f]	16.9	17.9	25.8	49.5	68.9	41.2	(30.0)	. .	. .	. .
Paraguay	37.6	36.6	34.1	42.6	44.1	47.3	49.7	46.0	. .	. .
Peru[e]	324	391	416	549	623	905	686	538	492	. .
Uruguay[e]	140	140	168	158	122	129	170	. .	. .	. .
Venezuela	527	508	705	793	579	679	699	697	746	746
Total South America	4 737	4 854	5 645	5 159	7 240	7 193	7 249	7 351	[6 512]	[6 352]

Table 5B.3. World military expenditure, in current price figures

Figures are in local currency, current prices.

	Currency	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
NATO											
North America:											
Canada	*mn dollars*	2 238	2 405	2 862	3 127	3 589	4 124	4 662	4 825	5 355	6 150
USA	*mn dollars*	77 639	78 358	85 906	90 948	91 013	100 925	109 247	122 279	143 981	167 764
Europe:											
Belgium	*mn francs*	45 183	50 533	57 739	70 899	81 444	89 480	99 726	106 472	115 754	124 055
Denmark	*mn kroner*	3 386	3 520	4 439	5 281	5 680	6 343	7 250	7 990	9 061	(10 194)
France	*mn francs*	37 992	42 284	47 878	55 872	63 899	73 779	85 175	96 439	111 672	129 365
FR Germany	*mn marks*	28 720	31 908	35 644	37 589	38 922	40 184	43 019	45 415	48 518	52 298
Greece	*mn drachmas*	16 809	19 991	31 499	45 936	56 963	67 738	77 861	89 791	96 975	125 944
Italy	*bn lire*	2 162	2 392	2 852	3 104	3 608	4 533	5 301	6 468	8 203	9 850
Luxembourg	*mn francs*	517	601	710	836	983	1 029	1 154	1 242	1 534	1 727
Netherlands	*mn guilders*	4 886	5 360	6 144	7 119	7 662	9 092	9 146	10 106	10 476	11 279
Norway	*mn kroner*	3 239	3 505	3 938	4 771	5 333	5 934	6 854	7 362	8 242	9 447
Portugal	*mn escudos*	16 046	16 736	25 108	19 898	18 845	22 082	27 354	34 343	43 440	51 774
Turkey	*mn lira*	9 961	12 192	15 831	30 200	40 691	49 790	66 239	93 268	185 656	313 067
UK	*mn pounds*	3 258	3 512	4 160	5 165	6 132	6 810	7 616	9 029	11 503	12 418
WTO											
Bulgaria	*mn leva*	391	422	483	548	596	653	681	(730)	(775)	(810)
Czechoslovakia	*mn korunas*	15 487	16 303	16 772	18 458	18 821	18 646	19 666	(20 515)	(22 650)	..
German DR	*mn marks*	6 528	6 900	7 083	7 512	7 994	8 261	8 674	(9 110)	(9 875)	(10 705)
Hungary	*mn forints*	9 430	9 488	10 564	11 811	11 671	12 607	14 984	15 397	16 264	(19 060)
Poland	*mn zlotys*	40 764	44 020	48 317	52 290	56 649	63 522	65 712	(70 655)	(70 875)	..
Romania	*mn lei*	7 710	7 835	8 744	9 713	10 575	10 963	11 713	11 835	(10 480)	(10 400)
USSR	*mn roubles*	[43 300]	[44 000]	[44 700]	[45 400]	[46 000]	[46 700]	[47 400]	[48 000]	[48 700]	[49 500]
Other Europe											
Albania	*mn leks*	590	590	610	635	783	805	825	835	915	..
Austria	*mn schillings*	4 900	5 324	6 565	7 946	8 728	9 515	10 767	11 541	12 423	12 864
Finland	*mn markkaa*	847	956	1 148	1 455	1 695	1 767	1 996	2 396	2 612	3 092
Ireland	*mn pounds*	24.8	31.5	36.8	58.5	71.8	84.1	95.0	118	144	..
Spain	*mn pesetas*	55 368	67 467	84 749	103 064	127 028	158 568	189 104	229 401	(277 575)	(327 500)
Sweden	*mn kronor*	7 306	7 823	8 666	9 781	10 768	12 054	13 466	14 975	16 216	17 374
Switzerland	*mn francs*	2 426	2 556	2 795	2 813	3 242	3 110	3 151	3 415	3 533	3 682
Yugoslavia	*mn new dinars*	11 716	14 108	21 100	28 815	33 234	38 766	43 379	(53 435)	(73 000)	(101 893)

Middle East											
Bahrain	*mn dinars*	4.9	5.8	9.3	5.8	9.3	14.3	40.5	53.9	59.2	[50.0]
Cyprus	*mn pounds*	3.9	3.9	6.7	7.2	7.3	10.4	8.9	12.6	(10.4)	(8.4)
Egypt	*mn pounds*	650	1 250	1 530	1 631	1 564	1 845	[1 300]	[1 200]	[1 300]	..
Iran	*bn rials*	82.4	124	314	452	546	563	584	[360]	[345]	..
Iraq[f]	*mn dinars*	153	199	422	470	520	593	587	790	..	..
Israel	*mn pounds*	5 804	(9 850)	(13 953)	(20 725)	(27 215)	(36 600)	(49 050)	(90 070)	[144 735]	..
Jordan[f]	*mn dinars*	44.1	47.3	51.2	56.7	103	94.5	95.3	130	(135)	(158)
Kuwait[f]	*mn dinars*	61.3	70.9	147	191	248	300	295	[295]	[500]	..
Lebanon	*mn pounds*	213	247	300	315	327	255	491	738	915	1 056
Oman	*mn riyals*	25.0	42.0	118	241	271	237	265	269	407	499
Saudi Arabia	*mn riyals*	3 246	4 830	(7 226)	(14 875)	(26 335)	(31 685)	[38 684]	[52 387]	[64 076]	[80 722]
Syria	*mn pounds*	793	1 485	1 682	3 345	3 690	4 160	4 573	8 282	8 415	9 378
United Arab Emirates	*mn dirhams*	..	51.6	79.9	124	312	1 928	3 019	4 394	(4 500)	..
Yemen Arab Republic	*mn rials*	92.6	127	197	286	411	572	1 180	..	..	..
Yemen, People's Democratic Rep. of[f]	*mn dinars*	9.6	10.3	12.5	15.4	17.1	20.0	27.1	36.3	(45.0)	..
South Asia											
Afghanistan	*mn afghanis*	[1 453]	1 457	1 562	1 834	2 353	2 673	2 938	..	..	..
Bangladesh	*mn taka*	..	312	565	910	1 407	1 665	1 692	1 981	2 365	2 796
India	*mn rupees*	16 205	16 736	20 043	23 822	25 399	26 158	27 921	29 987	(36 125)	(41 000)
Nepal	*mn rupees*	65.9	74.9	89.2	115	148	165	180	(270)	(387)	..
Pakistan	*mn rupees*	4 083	4 694	5 932	7 212	7 751	8 696	9 780	10 850	13 411	16 497
Sri Lanka	*mn rupees*	170	137	184	207	[245]	[224]	[309]	[411]	681	..
Far East											
Brunei	*mn dollars*	29.2	35.0	53.2	97.9	167	174	297	372	288	..
Burma	*mn kyats*	646	731	779	890	[1 099]	[1 220]	1 259	..	..	..
China	*mn yuan*	..	..	..	..	..	14 700	16 800	20 200	19 400	16 900
Hong Kong	*mn dollars*	126	118	117	117	219	354	543	(488)	(577)	1 264
Indonesia	*bn new rupiahs*	[157]	[264]	[406]	[602]	[722]	776	906	1 028	951	1 223
Japan	*bn yen*	767	901	1 053	1 268	1 466	1 646	1 848	2 046	2 196	2 357
Kampuchea	*mn riels*	16 956	26 073	48 320	..	..	..	..	..	..	..
Korea, North	*mn won*	1 256	1 247	1 557	1 864	2 058	(2 119)	2 345	2 563	2 750	3 010
Korea, South	*bn won*	194	202	321	465	770	1 008	1 438	1 597	2 167	2 764
Laos	*mn kips*	10 330	12 732	[14 606]	..	..	..	13 299	..	..	..
Malaysia	*mn ringgits*	774	904	1 103	1 314	1 219	1 517	1 692	1 809	2 900	(4 205)
Mongolia	*mn tugriks*	(192)	(213)	(362)	(373)	(407)	(405)	(421)	(480)	(426)	(700)
Philippines	*mn pesos*	855	1 941	(2 930)	(3 812)	4 614	4 924	4 863	4 659	[5 680]	6 700
Singapore[f]	*mn dollars*	477	553	650	779	927	1 072	1 091	1 151	1 230	1 415
Taiwan	*bn dollars*	22.1	25.8	32.4	38.3	45.7	[58.3]	[70.2]	80.7	96.5	113
Thailand	*mn baht*	5 738	6 238	7 295	10 438	11 823	13 000	15 650	19 857	23 219	28 625

	Currency	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Oceania											
Australia	*mn dollars*	1 105	1 245	1 556	1 849	2 099	2 364	2 535	2 774	3 200	3 775
Fiji	*mn dollars*	0.6	0.7	0.8	1.2	2.0	2.3	2.7	3.1	4.8	4.0
New Zealand	*mn dollars*	127	137	160	186	209	242	287	334	421	520
Africa											
Algeria	*mn dinars*	493	542	1 088	1 312	2 001	1 956	2 490	2 318	2 703	3 481
Benin	*mn francs*	1 894	1 377	1 544	1 691	1 759	(2 680)	. .	. .	. .	. .
Burundi	*mn francs*	429	474	605	672	860	1 256	1 533	(1 600)	. .	. .
Cameroon	*mn francs*	6 274	7 051	8 334	10 023	11 582	12 768	13 700	14 875	17 457	21 066
Central African Republic	*mn francs*	1 312	1 616	1 667	1 774	1 915	1 880	2 289	3 061	2 816	. .
Chad	*mn francs*	3 854	3 553	3 685	4 052	5 977	(7 370)	(9 330)	. .	. .	. .
Congo	*mn francs*	3 212	4 330	5 810	7 178	8 205	9 000	8 600	11 200	. .	. .
Equatorial Guinea	*mn ekueles*	[260]	[265]	[270]	[275]	. .	. .	. .	. .	. .	. .
Ethiopia	*mn birr*	95.9	102	154	258	265	279	518	722	[925]	. .
Gabon	*mn francs*	1 682	2 107	2 556	3 612	4 807	7 107	(12 160)	12 036	15 806	(11 000)
Ghana	*mn cedis*	40.0	47.9	73.7	90.6	126	157	202	(339)	[405]	. .
Guinea	*mn syli*	[725]	[750]	[750]	. .	. .	. .	. .	. .	. .	. .
Ivory Coast	*mn francs*	(5 500)	(6 400)	9 900	9 834	10 458	(13 000)	19 800	21 900	24 900	. .
Kenya	*mn pounds*	10.6	13.1	16.6	19.9	31.8	61.2	93.8	95.0	(85.0)	(90.0)
Liberia	*mn dollars*	3.8	3.7	3.7	4.5	5.4	7.3	8.8	12.8	. .	. .
Libya	*mn dinars*	(85.0)	(110)	(215)	(235)	(405)	(435)	(690)	. .	. .	. .
Madagascar	*mn francs*	4 065	4 536	6 231	6 470	8 504	10 732	11 775	17 420	. .	23 500
Malawi	*mn kwachas*	1.5	2.4	3.3	7.4	8.1	12.2	17.8	18.1	. .	. .
Mali	*mn francs*	4 195	4 890	5 600	8 100	10 456	12 751	14 080	15 331	. .	. .
Mauritania	*mn ouguiyas*	200	260	340	1 200	(1 975)	(2 830)	3 541	3 238	. .	. .
Mauritius	*mn rupees*	2.9	3.5	4.5	6.5	8.8	9.4	10.8	. .	. .	. .
Morocco	*mn dirhams*	645	763	1 057	1 673	2 548	3 294	3 209	3 495	(4 260)	(4 800)
Mozambique	*mn meticais*	. .	. .	. .	600	(1 760)	1 900	3 650	3 733	. .	5 600
Niger	*mn francs*	785	807	937	1 361	1 667	. .	. .	. .	. .	. .
Nigeria	*mn nairas*	350	408	504	1 008	1 069	1 219	1 139	1 114	1 246	1 319
Rwanda	*mn francs*	511	756	731	860	1 020	1 131	1 370	1 634	. .	. .
Senegal	*mn francs*	4 715	5 188	6 780	8 233	9 913	11 073	12 553	13 470	13 558	15 074
Sierra Leone	*mn leones*	3.4	4.1	5.0	5.9	6.3	10.3	[12.0]	. .	. .	. .
Somalia	*mn shillings*	92.0	101	135	145	165	200	422	592	. .	. .
South Africa	*mn rands*	327	438	655	913	1 257	1 578	1 675	1 813	2 020	2 496
Sudan	*mn pounds*	38.0	38.6	39.2	40.2	52.0	68.9	(77.7)	[140]	. .	. .
Tanzania	*mn shillings*	274	391	612	728	818	1 130	2 324	[2 444]	. .	. .
Togo	*mn francs*	1 063	1 261	1 604	1 960	3 153	4 118	4 789	(4 800)	4 900	. .

Tunisia	*mn dinars*	15.1	16.1	20.3	30.3	36.0	52.2	61.7	62.5	77.3	104
Uganda	*mn shillings*	462	416	535	642	835	1 089	1 078	775	[805]	..
Upper Volta	*mn francs*	1 247	1 355	1 509	3 871	4 667	5 627	7 305	6 814	...	..
Zaire	*mn zaires*	45.3	41.8	84.6	73.9	(82.0)	(31.0)	(38.0)	(200)	..	..
Zambia	*mn kwachas*	105	90.0	120	175	170	195	[205]	[235]	[230]	..
Zimbabwe	*mn dollars*	39.9	53.2	69.3	85.6	122	180	227	300	[307]	[265]
Central America											
Costa Rica[f]	*mn colones*	42.3	53.3	71.8	101	137	157	189	(180)	212	254
Cuba[f]	*mn pesos*	267	270	282	(326)	..	700	784	841	811	842
Dominican Republic	*mn pesos*	34.4	36.6	47.6	57.2	67.4	75.8	87.1	158	108	..
El Salvador[f]	*mn colones*	31.3	51.4	65.1	69.7	94.8	125	147	(170)	179	290
Guatemala	*mn quetzales*	22.5	21.5	27.4	42.9	49.6	77.7	73.2	84.6	..	..
Haiti	*mn gourdes*	39.1	39.9	42.3	50.9	55.8	60.9	73.5	..	..	..
Honduras	*mn lempiras*	30.9	31.9	33.8	42.8	47.4	50.5	62.8	..	..	..
Jamaica	*mn dollars*	7.1	13.2	15.4	20.0	26.6	28.2	..	..	..	..
Mexico	*mn pesos*	3 260	4 080	5 380	6 740	8 170	10 290	12 210	12 900	20 300	28 700
Nicaragua	*mn cordobas*	112	107	154	190	262	..	..	..	370	..
Panama	*mn balboas*	9.3	10.7	13.0	14.7	(15.3)	..	..	..	..	..
Trinidad and Tobago	*mn dollars*	8.0	7.3	9.5	13.0	16.0	19.3	..	..	..	..
South America											
Argentina	*bn new pesos*	3.5	4.4	6.4	[10.0]	180	415	1 187	3 479	5 623	11 977
Bolivia	*mn pesos*	271	418	786	1 157	1 325	1 374	1 636	1 865	2 592	..
Brazil	*mn cruzeiros*	5 030	6 740	8 740	11 220	19 030	25 870	36 880	48 100	62 340	125 000
Chile	*mn pesos*	6.0	42.0	441	1 631	5 065	11 300	19 932	35 421	[56 777]	[58 703]
Colombia	*mn pesos*	2 254	2 479	2 950	4 023	4 974	6 065	6 582	(9 010)	14 237	16 203
Ecuador	*mn sucres*	933	1 263	1 790	2 522	2 563	4 813	4 097	4 638	5 146	5 423
Guyana[f]	*mn dollars*	19.8	22.5	38.1	78.9	119	77.5	(65.0)	..	..	..
Paraguay	*mn guaranies*	1 941	2 135	2 481	3 315	3 587	4 204	4 891	5 793	..	..
Peru	*mn soles*	9 500	12 557	15 605	25 464	38 527	77 246	92 514	121 000	176 000	..
Uruguay	*mn new pesos*	30.6	60.0	128	218	254	425	811	..	..	..
Venezuela	*mn bolivares*	1 306	1 309	1 969	2 440	1 918	2 422	2 673	2 993	3 893	4 550

Table 5B.4. World military expenditure as a percentage of gross domestic product

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
NATO										
North America:										
Canada	2.1	1.9	1.9	1.9	1.8	1.9	2.0	1.8	1.8	1.8
USA	6.6	6.0	6.1	5.9	5.4	5.3	5.1	5.2	5.6	5.8
Europe:										
Belgium	2.9	2.8	2.8	3.1	3.1	3.1	3.3	3.3	3.3	3.3
Denmark	2.2	2.0	2.3	2.4	2.3	2.3	2.3	2.3	2.4	..
France	3.9	3.8	3.7	3.8	3.8	3.9	4.0	4.0	4.1	4.2
FR Germany	3.5	3.5	3.6	3.6	3.5	3.3	3.3	3.3	3.3	3.4
Greece	4.5	4.1	5.6	6.8	6.9	7.0	6.7	6.3	5.6	5.9
Italy	2.9	2.7	2.6	2.5	2.3	2.4	2.4	2.4	2.4	2.5
Luxembourg	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.2	1.3
Netherlands	3.3	3.2	3.2	3.4	3.2	3.5	3.2	3.4	3.3	3.4
Norway	3.3	3.1	3.0	3.2	3.1	3.1	3.2	3.1	2.9	2.9
Portugal	6.9	5.9	7.4	5.3	4.0	3.5	3.5	3.5	3.6	3.6
Turkey	4.3	6.2	3.9	5.8	6.2	5.8	5.2	4.3	4.3	4.8
UK	5.1	4.8	5.0	4.9	4.9	4.8	4.6	4.7	5.1	5.0
WTO[g]										
Bulgaria	2.7	2.7	2.8	3.0	3.0	3.2	3.2	(3.2)	(2.9)	
Czechoslovakia	3.3	3.2	3.0	3.2	3.1	3.1	3.1	(3.1)	(3.2)	
German DR	4.1	4.1	4.0	4.0	4.1	4.0	4.1	(4.2)	(4.4)	
Hungary	2.3	2.1	2.2	2.3	2.1	2.1	2.3	2.2	2.2	
Poland	3.3	3.0	2.9	2.8	2.6	2.7	2.6	(2.7)	(2.8)	
Romania	2.2	2.1	2.1	2.2	2.2	2.1	2.1	2.0	..	
USSR	[11.4]	[10.8]	[10.4]	[10.3]	[9.9]	[9.5]	[9.2]	[9.1]	..	
Other Europe										
Austria	1.0	1.0	1.1	1.2	1.2	1.2	1.3	1.3	1.2	
Finland	1.5	1.4	1.3	1.4	1.5	1.4	1.4	1.5	1.4	
Ireland	1.1	1.2	1.2	1.6	1.6	1.6	1.5	1.6	1.7	
Spain	1.6	1.6	1.7	1.7	1.8	1.7	1.7	1.7	..	
Sweden	3.7	3.6	3.4	3.3	3.2	3.3	3.3	3.3	3.1	
Switzerland	2.1	2.0	2.0	2.0	2.3	2.1	2.1	2.2	2.1	
Yugoslavia[h]	4.9	4.7	5.5	5.9	5.6	5.3	4.9	(4.6)	..	
Middle East										
Bahrain	..	3.9	3.0	1.6	1.7	2.2	..	..	..	
Cyprus	1.3	1.2	2.2	2.9	2.2	2.5	1.8	2.0	(1.4)	

Egypt	19.0	34.1	36.5	33.4	24.9	22.5	[13.3]	[9.6]	. .
Iran	6.4	7.0	11.0	13.0	12.4	10.9	. .	. .	. .
Iraq	10.6	12.2	12.5	11.7	11.2	10.4	. .	. .	. .
Israel	19.2	(25.6)	(25.6)	(26.7)	(27.2)	(25.5)	(20.9)	(20.2)	[14.0]
Jordan	21.3	21.7	20.7	20.4	25.6	19.8	16.5	18.3	(15.5)
Kuwait	4.2	4.5	4.5	5.4	6.6	7.5	7.1	[5.0]	. .
Lebanon	3.3	3.5	3.7	4.2	. .	3.1	5.6	6.6	. .
Oman	17.8	24.8	20.8	33.3	32.8	26.9	29.6	22.9	22.3
Saudi Arabia	9.4	6.9	(6.0)	(9.8)	(14.3)	(14.8)	[16.3]	[16.5]	. .
Syria	8.9	15.8	10.5	16.2	14.8	15.3	14.0	21.1	16.6
United Arab Emirates	. .	0.5	0.3	0.3	0.6	3.0	5.0	5.5	(4.1)
Yemen Arab Republic	4.0	4.4	5.1	5.9	6.5	. .	. .	. .	. .
Yemen, People's Democratic Rep. of	14.8	15.1	16.0	. .	. .	. .	. .	. .	. .
South Asia									
Bangladesh	. .	0.5	0.6	0.8	1.3	1.4	1.2	1.3	. .
India	3.5	3.0	3.0	3.3	3.2	3.0	2.9	2.8	. .
Nepal	0.6	0.7	0.6	0.7	0.9	0.9	0.9	(1.2)	. .
Pakistan	6.8	6.1	6.0	5.9	5.5	5.4	5.3	5.0	5.2
Sri Lanka	1.1	0.7	0.8	0.8	[0.8]	[0.6]	[0.7]	[0.8]	1.0
Far East									
Brunei	3.8	3.6	2.1	3.6	4.9	. .	. .	. .	. .
Burma	5.6	5.2	4.3	4.0	[4.2]	[4.2]	4.0	. .	. .
Hong Kong	0.5	0.4	0.3	0.3	0.5	0.7	0.8	(0.6)	(0.6)
Indonesia	[3.6]	[4.3]	[4.2]	[5.0]	[4.9]	4.3	4.2	3.6	2.3
Japan	0.9	0.8	0.8	0.9	0.9	0.9	0.9	1.0	. .
Korea, North	. .	. .	13.0	13.9	14.1	. .	. .	. .	. .
Korea, South	4.8	3.8	4.3	4.7	5.8	5.9	6.2	5.4	6.0
Malaysia	5.4	4.9	4.8	5.9	4.4	4.7	4.6	4.1	5.6
Philippines	1.5	2.7	(2.9)	(3.3)	3.4	3.2	2.7	2.1	[2.1]
Singapore	5.8	5.3	5.2	5.8	6.4	6.7	6.2	5.9	. .
Taiwan	7.8	7.4	7.1	7.1	7.5	[8.3]	[8.5]	. .	. .
Thailand	3.5	2.9	2.7	3.5	3.5	3.3	3.3	3.6	3.4
Oceania									
Australia	2.9	2.9	3.0	3.0	2.9	2.9	2.8	2.7	2.8
Fiji	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	. .
New Zealand	1.7	1.6	1.6	1.7	1.6	1.6	1.7	1.7	. .
Africa									
Algeria	1.8	1.7	2.2	2.3	2.9	2.4	. .	. .	. .
Benin	2.3	1.5	1.4	1.5	1.3	(1.8)	. .	. .	. .

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Burundi	2.0	1.9	2.2	2.1	2.2	2.6	2.8	(2.2)	..	
Cameroon	1.7	1.6	1.6	1.6	1.6	1.5	1.3	..	..	
Chad	4.1	3.9	3.2	2.7	3.8	(4.6)	..	..	..	
Congo	..	..	..	4.4	4.6	..	4.3	..	..	
Ethiopia	2.0	1.9	2.8	4.5	4.1	4.0	6.8	8.8	..	
Gabon	1.6	1.3	0.7	0.8	0.7	1.0	(2.3)	1.9	..	
Ghana	1.4	1.4	1.6	1.7	1.9	1.4	..	..	..	
Ivory Coast	(1.2)	(1.1)	1.3	1.2	0.9	(0.8)	1.1	..	..	
Kenya	1.4	1.5	1.6	1.7	2.2	3.3	4.6	4.2	(3.3)	
Liberia	0.8	0.9	0.6	0.6	0.7	0.8	0.9	1.2	..	
Libya	(4.7)	(4.9)	(5.5)	(6.2)	(8.3)	(7.5)	(11.7)	..	..	
Madagascar	1.5	1.5	1.7	1.6	2.0	2.3	2.5	3.0	..	
Malawi	0.4	0.6	0.7	1.3	1.2	1.6	2.0	1.7	..	
Mauritania	1.5	2.1	2.1	6.3	(8.7)	(11.6)	14.1	11.6	..	
Mauritius	0.2	0.2	0.1	0.2	0.2	0.2	0.2	..	..	
Morocco	2.8	3.1	3.1	4.6	6.2	7.0	5.8	5.6	(6.1)	
Nigeria	4.6	4.7	3.4	5.2	4.4	4.5	4.0	..	..	
Rwanda	2.3	3.1	2.5	1.6	1.7	1.6	1.7	1.7	..	
Senegal	1.8	1.9	2.2	2.2	2.3	2.3	2.6	2.6	..	
Sierra Leone	0.9	0.9	0.9	1.0	0.9	1.3	[1.3]	..	..	
South Africa	2.0	2.2	2.7	3.3	4.1	4.6	4.2	3.8	3.2	
Sudan	4.4	3.6	2.8	2.4	2.5	2.6	..	..	..	
Tanzania	2.5	3.0	3.8	3.8	3.5	3.8	6.9	[6.6]	..	
Togo	1.5	1.4	1.8	1.5	2.5	3.0	2.8	(2.5)	2.3	
Tunisia	1.4	1.4	1.3	1.8	1.9	2.4	2.5	2.1	2.2	
Uganda	4.1	3.2	3.3	2.9	3.2	2.2	1.7	..	..	
Upper Volta	1.1	1.2	1.2	2.7	2.9	2.9	3.4	2.6	..	
Zaire	3.9	2.8	4.7	3.9	(2.9)	(0.8)	(0.7)	(1.8)	..	
Zambia	7.8	5.7	6.3	11.1	9.1	10.0	[9.1]	[9.0]	..	
Zimbabwe	2.8	3.4	3.7	4.3	5.6	8.1	9.7	11.3	..	
Central America										
Costa Rica	0.5	0.5	0.5	0.6	0.7	0.6	0.6	(0.5)	0.5	
Cuba[h]	4.1	3.7	3.6	(3.7)	..	7.3	7.6	..	..	
Dominican Republic	1.7	1.6	1.6	1.6	1.9	1.7	1.9	2.9	1.6	
El Salvador	1.1	1.5	1.7	1.6	1.7	1.8	1.9	(1.9)	2.1	
Guatemala	1.1	0.8	0.9	1.2	1.1	1.4	1.2	1.2	..	
Haiti	1.6	1.2	1.2	1.1	0.9	0.9	..	..	..	
Honduras	1.8	1.7	1.6	1.9	1.8	1.6	1.7	..	..	
Jamaica	0.5	0.8	0.7	0.8	1.0	0.9	..	..	..	

Mexico	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5
Nicaragua	1.8	1.4	1.5	1.7	2.0	..	..	..	..
Panama	0.7	0.7	0.7	0.8	(0.8)	..	..	..	..
Trinidad and Tobago	0.4	0.3	0.2	0.2	0.2	0.2	..	..	..
South America									
Argentina	1.6	1.2	1.3	[0.7]	2.2	2.0	2.3	2.5	2.0
Bolivia	1.6	1.6	1.8	2.3	2.3	2.1	2.0	1.8	1.7
Brazil	1.4	1.4	1.2	1.1	1.2	1.1	1.1	0.8	0.5
Chile	2.5	3.5	4.6	3.9	3.5	3.5	4.1	4.6	[5.2]
Colombia	1.2	1.0	0.9	1.0	0.9	0.8	0.7	(0.8)	0.9
Ecuador	2.0	2.0	1.9	2.3	1.9	3.0	2.2	2.0	1.8
Guyana	3.3	3.5	4.0	6.6	10.7	6.9	(5.1)	..	..
Paraguay	2.0	1.7	1.5	1.7	1.7	1.6	1.5	1.3	..
Peru	3.2	3.5	3.5	4.6	5.0	7.3	5.5	4.0	3.6
Uruguay	2.5	2.4	2.8	2.6	1.9	2.1	2.7	..	..
Venezuela	2.1	1.7	1.8	2.1	1.4	1.6	1.6	1.4	1.6

Conventions

.. Information not available or not applicable.

( ) SIPRI estimates.

[ ] Imputed values, with a high degree of uncertainty.

Notes

[a] *Developed market economies* include all NATO countries, Other Europe except Albania and Yugoslavia, plus Australia, New Zealand, Japan, Israel and South Africa.
Centrally planned economies include all WTO countries, Albania, North Korea, Mongolia, China and Cuba.
OPEC countries include Iran, Iraq, Kuwait, Saudi Arabia, United Arab Emirates, Indonesia, Algeria, Gabon, Libya, Nigeria, Ecuador and Venezuela. Qatar, although a member of OPEC, is not included. Oman, although it is not a member of OPEC, is included, since its position is essentially similar to that of other Arab OPEC countries.
Non-oil developing countries include the rest of the world, excluding Kampuchea, Laos and Viet Nam.
Southern Africa includes Mozambique, Tanzania, South Africa, Zambia and Zimbabwe.
[b] At current prices and 1979 exchange-rates.
[c] At current prices and 1978 exchange-rates.
[d] At 1978 prices and 1978 exchange-rates.
[e] See section on inflation in appendix 5C.
[f] Include internal security, etc.
[g] Per cent of gross national product.
[h] Per cent of gross material product.

Appendix 5C

Sources and methods for the world military expenditure data

Square-bracketed numbers, thus [1], *refer to the list of references on page* 158.

This appendix describes the sources and methods used in the preparation of the tables on military expenditure (appendix 5B). Only the main points are noted here. The tables are updated and revised versions of those which appeared in the *SIPRI Yearbook 1981.* It is important to note that these revisions can be quite extensive—not only are significant changes made in figures which were previously estimates, but entire series are altered when new and better sources come to light.

I. Purpose of the data

The main purpose of the SIPRI data is to give some measure of the resources absorbed by the military sector in various countries, regions and in the world as a whole—that is, the 'opportunity cost' of military spending. The purpose is *not* to provide a measure of military strength. For a large number of reasons (*inter alia*, because of differences in coverage, the difficulty in finding appropriate exchange-rates, the fact that price conditions vary widely between countries, because money may be spent on ineffective weapons, and because there is no reason to suppose that defence necessarily costs the same as offence), expenditure figures are inappropriate for this purpose.

For many small countries receiving large amounts of military aid, the military expenditure figures considerably understate the volume of military activity. This is naturally also the case for countries with a foreign military presence.

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

II. Definitions

The data for NATO countries are estimates made by NATO to correspond to a common definition. These include military research and development; include military aid in the budget of the donor country and exclude it from the budget of the recipient country; include costs of retirement pensions, costs of para-military forces and police when judged to be trained and equipped for military operations; and exclude civil defence, war pensions and payments on war debts.

The NATO definition is used as a guideline for all countries, especially when choosing between alternative series. Thus the figures published in the *Government Finance Statistics Yearbook* (GFS) are preferred to those given in other sources, since the definition which the GFS uses [1] by and large agrees with the NATO definition.

However, for some countries, it was not possible to obtain sufficient information about their published defence budgets to make an assessment of whether, or to what extent, these diverged from the NATO definition. For other countries there *is* information as to what their official defence budgets include, but not sufficient material available to make the proper adjustments. This is the case, among others, with the military expenditure estimates chosen for the Warsaw Treaty Organization (WTO) countries other than the Soviet Union. An adjustment is made for Czechoslovakia, the German Democratic Republic and Poland to include some estimates for military research and development expenditure financed outside of defence budget appropriations, and to exclude an estimated 'civilian' portion of internal security for the German Democratic Republic, whose published budget appropriation figures up to and including 1976 reflect defence and internal security taken together. There are, however, other items for which adjustments have been impossible. "No attempt has been made to assess industrial investments related to armaments production. Nor has any attempt been made to include here the various military related outlays known to be financed outside the defense budgets proper, such as benefits to soldiers' families and paid leave for reservists. Investment expenditures made directly by ministries of defense, however, are implicitly included" [2a].

For calculating the ratio of military expenditure to national product, gross domestic product (GDP) at purchasers' values has been used. GDP 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" [3]. For the WTO countries, military expenditure is 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.

Coverage

The tables of military expenditures cover 130 countries.

The countries 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 every year since 1972. Series for each year since 1950 are published in previous volumes of the *SIPRI Yearbook* and are also available on request for specific countries.

III. Sources

The estimates of military expenditure for NATO countries are taken from official NATO data, published annually in, for example, *NATO Review* and *Atlantic News*. The estimates for WTO countries other than the USSR are taken from reference [2b] for the years up to and including 1978. For the years after 1978, the official budget percentage changes were used to extend the series. For the Soviet Union, a 'compromise' figure has been taken, which corresponds neither with the official figures nor with the US Central Intelligence Agency estimates; the reasons are explained in the *SIPRI Yearbook 1979* (page 28).

Official figures for China, for 1977–81, have now been released, for the first time since 1960. They do not include expenditure on military research and development and they have therefore been increased by 10 per cent to allow for this.

For the remaining countries, the prime sources are the GFS, published by the International Monetary Fund; the United Nations' *Statistical Yearbook* (UNSY); and the United Nations' *Statistical Yearbook for Asia and the Pacific* (UNSYAP).

The GFS is considered superior to the UNSY, since it attempts to present the figures in a uniform manner, while the latter gives the figures unadjusted in the form they are notified by governments to the United Nations.

For a number of countries, estimates are made on the basis of budgets, White Papers and statistical documents published by the government or the central bank of the country concerned.

Annual reference works are usually not very useful, since they have a tendency to quote each other when giving military expenditure figures. An exception is the *Europa Year Book* (London) which is useful especially for small nations.

The countries for which figures have been impossible to find in these sources present difficulties. The estimates of their military spending have been derived from other sources and are therefore highly approximate.

The figures for the latest years in the series have mainly been obtained from the journals and newspapers listed in the *SIPRI Yearbook 1979*, pages 62–63, together with the other sources used.

The data on GDP, consumer price index and exchange-rates are taken principally from *International Financial Statistics*, published by IMF, and from the *United Nations Monthly Bulletin of Statistics.*

The GNP estimates for the USSR were obtained by converting the GNP dollar-estimate for 1975 given in reference [4a] 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 [2c] for the years up to and including 1978; for the years from 1979, they were calculated using the net material product series.

IV. Methods

All figures are presented on a calendar-year basis. Conversion to calendar years was made on the assumption of an even rate of expenditure throughout the fiscal year. Figures for the most recent years are budget estimates. When the latest figures differed from the previous series chosen, the percentage change from the latest source was applied to the existing series in order to make the trend as correct as possible.

In order to provide time series estimates of total world military expenditure at constant prices, so as to allow for volume comparisons, two operations must be performed. First, all national expenditures must be converted into a common currency. The US dollar is the most widely used currency for this purpose, and SIPRI has adopted this practice. Second, it is necessary to adjust for the effect of price changes. The figures in this *Yearbook* are presented at 1979 price levels and 1979 exchange-rates, using, wherever available, the average for the year.

For the WTO countries other than the USSR, the exchange-rates given in reference [2c] were used. Updating was done by using the basic and non-commercial rates. 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 [4b], updated by the change in the US consumer price index from 1975 to 1979, which brings it to 2.4 dollars per rouble. The Chinese rate of exchange is arrived at by considering Chinese costs in terms of US prices and *vice versa.* This very roughly approximates to a rate of 2 dollars to the yuan.

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 6–10 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 figures for 'constant price' military expenditure become more unreliable when inflation is rapid. In the following countries, prices more than quadrupled between 1975 and 1980.

(*Price index numbers, 1975=100*)

Turkey	723	Argentina	21 524
Israel	1 097	Brazil	790
Ghana	1 355	Chile	1 511
Uganda (1978)	377	Peru	772
Zaire	1 339	Uruguay	940

In these countries in particular, supplementary budgets are likely to be presented in the course of the year, which are on occasions difficult to trace.

The calculations of the ratio of military expenditure to GDP/GNP were made in domestic currencies. In international comparisons this procedure tends to underestimate the defence burden in the centrally planned economies due to the pricing policies practised there. This has been explained with reference to the WTO countries other than the Soviet Union as follows:

> Comparisons based on such shares will be meaningful only if the basis of valuation of the defense and nondefense (civilian) components of GNPs of various countries is more or less uniform. However, in the East European centrally planned economies, the prices of civilian consumption goods and services, because of the heavy incidence of turnover taxes, most probably are relatively high in relation to prices of military hardware and other procurement items, on which turnover taxes generally are not imposed. Also, very probably, the production of defense items is heavily subsidized through financial transfer at the state budget or lower levels. [2d]

References

1. SIPRI, *World Armaments and Disarmament, SIPRI Yearbook 1981* (Taylor & Francis, London, 1981), p. 172.
2. Alton, T. P., Lazarcik, G., Bass, E. M. and Znayenko, W., 'East European defense expenditures, 1965–78', in *East European Economic Assessment, Part 2*, A compendium of papers submitted to the Joint Economic Committee, US Congress (US Government Printing Office, Washington, D.C., 1981).
   (a) —, pp. 419–20.
   (b) —, pp. 418–19.
   (c) —, pp. 413–14.
   (d) —, p. 412.

3. *Statistical Yearbook* (United Nations, New York, 1974), p. XVII.
4. Sivard, Ruth L., *World Military and Social Expenditures* (WMSE Publications, Leesburg, Virginia, March 1978).
   (a) —, p. 21.
   (b) —, p. 30.

Appendix 5D

The development and production of armoured vehicles

In spite of the development of precision-guided munitions such as deep-penetrating anti-tank missiles, main battle tanks (MBTs) and other armoured vehicles continue to form a major part of the armies of the world. They have, however, undergone substantial changes in recent years. A main battle tank used to consist of an armoured shell, a gun and mechanical components. Today, in addition to improved versions of these elements, electronic components are added which are becoming increasingly sophisticated. A modern tank, such as the US M-1 Abrams, has a 360° mount for its high-velocity gun and a high horsepower-to-weight ratio for improved speed and acceleration. It has a highly sophisticated target designation and fire control system including a new laser range-finder, a ballistic computer with automatic stabilization and an integral thermal sight for night vision capability. With the aid of these electronic devices, the M-1 has a better hit probability on the move than its predecessor, the M-60, has while stationary. The electronic systems nowadays account for more than 30 per cent of the approximately $3 million that is the current unit cost of modern tanks such as the M-1, the West German Leopard-2 or the British Challenger.

In spite of the enhanced capabilities of the MBTs, there is today a trend towards lighter and more mobile vehicles. Experience from the Middle East wars, and from the Iran–Iraq war in particular, has shown the advantages of fast and well-armed vehicles with relatively light armour protection. New tactical requirements such as air transportability are also important. In the United States, for example, two programmes for new lightweight vehicles intended primarily for the Rapid Deployment Force are currently under way. These programmes, the Light Armoured Vehicle (LAV) and the Mobile Protected Weapon System (MPWS) for the Marine Corps and the Army, are typical examples of armoured vehicle developments today. The new importance attributed to these light vehicles is also shown by the increasing number of variants of each individual vehicle. Their roles include for example infantry combat, anti-tank, air defence, mortar carrier, command/control, recovery, ambulance, cargo, engineer and electronic warfare missions. Another notable feature of light armoured vehicle development is the increasing number of hybrids. Guns, turrets and chassis are becoming more and more interchangeable, leading to an unlimited number of possible combinations. The Wolverine, for example, is a new US vehicle with Vought Corporation as main contractor. The fire control system is from Texas Instruments, the 105-mm gun is built by the West German company Rheinmetall, and the chassis is a French GIAT AMX-10RC.

Register of armoured vehicles in production or under development in industrialized and Third World countries, 1981

Countries are listed alphabetically. The armoured vehicles are listed alphabetically by weapon designation. For sources and methods for the world arms production data, and for the abbreviations and conventions used in the register, see appendix 6D. The register identifies 213 different armoured vehicles currently in production or under development. Some 95 of these are various kinds of APCs and ICVs, while 38 are MBTs. When grouped on a producer basis, it is found that France is responsible for 31 entries, followed by the USA (28), the UK (26), FR Germany (19) and the USSR (13). The low figure for the USSR is partly explained by its high degree of weapon sophistication and partly by the fact that different versions of the same basic vehicle are more easily identifiable for the Western countries.

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
15 Argentina	Model 77 155mm	TH	CITEFA	..	22	8	..	..	..	..	Development of French Mk F3 howitzer
	TAM	MT	Rio Tercero/Buenos Aires	75	900	30	1974	1976	1979	..	Licence agreement with FR Germany of 1974; developed by Thyssen-Henschel for Argentinian Army; arms: 105mm gun
	VAB	APC		92	1000	12	..	..	1982	..	To be built in 4x4 and 6x6 configuration
	VCI	ICV		72	870	27	..	1977	1980	..	Licence agreement with FR Germany of 1976; now in production
7 Austria	Cuirassier	LT/TD	Steyr-Daimler-Puch	65	530	17	1965	1967	1972	..	Also designated SK-105; arms: 105mm gun
	Steyr-4K 7FA	APC	Steyr-Daimler-Puch	63	520	14	..	..	..	..	Upgraded version of the Saurer-4K 4FA
4 Belgium	AIFV	MICV	Belgian Mechanics	61	480	12	1979	..	1980	..	Licence agreement with the USA of 1980; 1 200 M-113-A1s and AIFVs on order
	BDX	APC	Beherman-Demoen	100	900	9	..	..	1978	..	Licence agreement with Ireland of 1976; upgraded version of Timoney; can be fitted with ATMs

		Cobra	APC	ACE de Charleroi	80	600	6	1977	1979	..	..	Ready for production
		GC-45 155mm	TH	SRC International	..	30	8	1975	1977	1979	..	Jointly developed with Canada
		M-113-A1	APC	Belgian Mechanics	67	483	9	..	..	1980	..	Licence agreement with the USA of 1980
		M-114/39 155mm	TH	SRC International	..	26	7	..	..	1979	..	Modified version of the US M-114-A1 towed howitzer
		Sibmas	APC	BNCFM	116	1400	12	1975	1976	..	..	Amphibious; ready for production; adaptable for anti-tank, cargo, CPC and ambulance roles
15	Brazil	EE-11 Urutu	APC	Engesa	95	600	11	1970	1970	1972	..	Amphibious
		EE-17 Sucuri	TD	Engesa	110	600	17	..	1976	1977	..	Arms: 105mm gun and MGs
		EE-3 Jararaca	SC	Engesa	90	600	5	..	..	1978	..	
		EE-9 Cascavel	AC	Engesa	100	750	10	1970	1972	1974	1974	
			TH		..	..	..	..	..	1980	1980	Acceptance trials started in 1980; 105mm
		X-30	MBT	Bernardini	..	..	..	1980	1981	..	..	Under development; based on M-41 chassis; arms: 105mm gun
		X1-A2	MT	Bernardini	55	750	19	1975	..	1979	..	Arms: 90mm gun; also available as BL and RL
4	Canada	Cougar	AC	General Motors, Canada	100	600	7	..	..	1978	..	Licence agreement with Switzerland of 1977 for production of the Piranha; incl Grizzly and Husky versions
		Grizzly	APC	General Motors, Canada	100	600	7	..	..	1978	1978	
		Husky	ARV	General Motors, Canada	100	600	7	..	..	1978	..	
15	Chile	Piranha	APC	Cardoen SS	100	700	7	..	..	1981	..	Licence agreement with Switzerland of 1980
3	China	K-63	APC	Chinese State Arsenal	50	400	12	..	..	1969	..	Probably still in production
		T-59	MBT	Chinese State Arsenal	48	400	34	..	..	1958	..	Copy and development of Soviet T-54
		T-60	LT	Chinese State Arsenal	40	240	15	..	..	1972	..	Version of Soviet PT-76
		T-62	LT	Chinese State Arsenal	..	..	21	..	..	1958	..	Downgraded version of T-59 MBT
		T-63	LT	Chinese State Arsenal	40	240	17	..	..	..	..	Development of T-60 LT

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
	Type 59-1 130mm	TG	Chinese State Arsenal	. .	22	. .	. .	. .	. .	. .	Indigenously designed field gun now in production; supplied to Viet Nam and Pakistan
	Type 54 122mm	SPH	Chinese State Arsenal	. .	. .	. .	. .	. .	. .	. .	Based on K-63 APC chassis with 122mm howitzer mounted in the rear
	Type 55	APC	Chinese State Arsenal	80	650	5	. .	. .	. .	. .	Chinese version of BTR-40
5 Czechoslovakia	OT-64	APC	Czechosl. State Arsenal	94	710	12	1959	. .	1964	. .	Jointly developed by Czechoslovakia and Poland
	T-72	MBT	Czechosl. State Arsenal	80	500	41	. .	. .	1980	. .	Licence agreement with the USSR of 1978
7 Finland	PS-691	APC	Vammakoski	37	. .	9	. .	1977	. .	. .	New Finnish APC; unclear whether yet in production
4 France	AML-90	AC	Panhard-Levassor	90	600	8	. .	1959	1961	1961	Available in numerous versions; also produced in South Africa as the Eland AC
	AMX-10 PAC-90	MICV/SPG	Roanne	65	600	14	1965	1968	1972	1973	Same as 10P but with new turret and 90mm gun
	AMX-10P	MICV	Roanne	65	600	11	1965	1968	1972	1973	Produced in several versions incl anti-tank (18 HOT ATMs), recce and CPC
	AMX-10RC	Recce AC	Roanne	85	800	14	1970	1971	1976	. .	Arms: 105mm gun and MG; amphibious
	AMX-13	LT	Creusot-Loire	60	400	15	1946	. .	1952	. .	Still in production
	AMX-13 ARV	ARV	Creusot-Loire	. .	. .	15	. .	. .	1955	. .	Arms: 7.62mm MG
	AMX-13 BL	BL	Creusot-Loire	. .	. .	15	. .	. .	. .	. .	Weight with bridge: 20t; speed with bridge: 4km/h
	AMX-13-105	LT	Creusot-Loire	60	400	15	. .	. .	1967	. .	Arms: 105mm gun; export version
	AMX-13-90	LT	Roanne	60	400	15	. .	. .	1960	. .	Arms: 90mm gun
	AMX-155 GCT	SPG	Roanne	60	450	38	1969	1972	1977	. .	
	AMX-155 Mk-F3	SPH	Creusot-Loire	65	300	17	. .	. .	1954	. .	Based on AMX-13 chassis; developed in the late 1950s

AMX-30	MBT	Roanne	65	600	36	1957	1960	1966	. .	Production rate: 20/month in 1979/80; will be up-dated during the 1980s with new 120mm gun, fire control and laser range-finder; modified version designated Valorise
AMX-30 DCA	AAV	Roanne	60	600	36	. .	. .	1976	. .	In production for Saudi Arabia; uncertain whether completed
AMX-30S	MBT	Roanne	60	600	36	. .	1975	1976	. .	For desert operations; sand shields and laser rangefinder
AMX-32	MBT	Roanne	. .	. .	. .	. .	. .	. .	. .	Development of AMX-30; not yet in production; probably for export since AMX-30 Valorise will be in service through the 1980s
AMX-VCI	MICV	Creusot-Loire	65	400	12	1954	1955	1957	. .	Based on AMX-13 chassis
EMC-81	AC	Panhard-Levassor	110	950	7	1975	1977	1978	1979	Mortar version of ERC-vehicles
ERC-120 Guepard	AC	Panhard-Levassor	110	950	7	1975	1977	1978	1979	Arms: 20mm gun
ERC-60 Serval	AC	Panhard-Levassor	110	950	7	1975	1977	1978	1979	Arms: 60mm gun
ERC-90 Lynx	AC	Panhard-Levassor	110	950	7	1975	1977	1978	1979	Arms: 90mm gun
ERC-90S Sagaie	AC	Panhard-Levassor	110	950	7	1975	1977	1978	1979	Arms: 90mm gun
Javelot	AAV	Thomson-CSF/ Thomson-Brandt	. .	. .	. .	1969	. .	. .	. .	Rapid-fire AAV based on AMX-30 chassis; Pulse-Doppler radar; some fund-ing from the USA; status: being developed
M3	APC	Panhard-Levassor	90	600	5	. .	1969	1971	1971	
M3-VDA	AAV	Panhard-Levassor	90	1000	6	1972	1973	1975	. .	
	TH	GIAT	. .	30	9	1975	1979	1980	. .	Similar to Swedish FH-77 and FH-70 International; 155mm
VAB	APC	Saviem/Creusot-Loire	92	1000	12	1969	1972	1975	1976	In 4x4 and 6x6 configu-ration; amphibious; wide range of versions
Vadar	AAV	GIAT/Saviem/Thomson-CSF	92	1000	14	. .	1979	. .	. .	Based on Saviem VAB chassis; not yet in production

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
	VBC-90	AC	Renault	92	1000	. .	. .	1979	1981	. .	Similar to VAB; arms: 90mm gun
	VCR-4	APC	Panhard-Levassor	100	950	7	. .	. .	1980	. .	Probably replacing M3 APC in French Army; 4x4 configuration
	VCR-6	APC	Panhard-Levassor	110	950	7	1975	1977	1978	. .	6x6 configuration; also in anti-tank and ambulance versions
	VPX-110	TD	Lohr	90	400	2	. .	1977	1980	. .	Light tracked anti-tank vehicle; can carry HOT and MILAN ATMs; derivatives: VPX-5000 and PPX-6000 (wheeled)
16 France/Germany, FR	Dragon	AAV	Thomson-CSF/Thyssen	72	1000	32	1979	1979	1980	. .	Interoperability with Roland on Marder chassis and with TAM MBTs
	Napoleon-1	MBT		. .	. .	. .	. .	. .	. .	. .	Proposed new MBT to replace AMX-30/32 and Leopard-2 in the 1990s; uncertain whether co-operation feasible; also designated MBT-90
4 Germany, FR	Alligator	Recce AC	EWK	83	800	14	1971	1977	. .	. .	Amphibious wheeled recce vehicle to enter service in 1984; development of Tpz-2
	Condor	APC	Thyssen-Henschel	105	500	7	. .	. .	1975	. .	Development of UR-416
	Jaguar-1 Rjpz	TD	Thyssen-Henschel	70	400	23	. .	. .	1977	1978	Conversion of Rjpz-2 TDs; arms: K3S system for HOT ATMs
	Leopard AEV	AEV	MaK	60	. .	40	. .	. .	1968	. .	
	Leopard ARV	ARV	MaK	65	. .	42	. .	. .	1966	. .	
	Leopard BL	BL	MaK	65	600	45	. .	. .	1975	. .	Bridge-span: 20m
	Leopard-1-A3	MBT	Krauss-Maffei	65	600	42	. .	. .	1970	. .	
	Leopard-1-A4	MBT	Krauss-Maffei	65	600	42	. .	. .	1972	. .	
	Leopard-2	MBT	Krauss-Maffei	68	500	55	1969	1972	1978	. .	Production rate: 25/month

												from 1982; arms: 120mm gun
		Leopard-3	MBT	Krauss-Maffei/MaK	. .	. .	38	1979	. .	. .	. .	Status: development
		Marder	MICV	Rheinstahl/MaK	75	520	28	1960	1967	1970	1971	Production completed but line can be re-opened if orders are received
		Pionerpanzer-2	AEV	EWK	62	. .	51	. .	1980	1980	. .	
		Begleitpanzer	LT	Thyssen-Henschel	78	550	30	. .	1977	. .	. .	Trials; based on Marder chassis; arms: Bofors 57mm gun, MG and TOW; also being developed in AAV-version
		TM-125	APC	Thyssen	87	700	5	. .	1978	1979	. .	
		TM-170	APC	Thyssen	100	670	7	. .	1978	1979	. .	
		TM-90	APC	Thyssen	110	600	3	. .	1978	1979	. .	
		Tpz-1	APC	Thyssen-Henschel	87	800	14	. .	. .	1979	. .	Production rate: 160/year
		UR-416	APC	Thyssen-Henschel	85	700	5	. .	1965	1969	. .	
		Wildcat	AAV	Krauss-Maffei	100	. .	14	1979	1981	1981	. .	Arms: 2x30mm Mauser gun
16	Germany, FR/ Italy/UK	SP-70 155mm	SPG	Rheinmetall/OTO-Melara/ Royal Ordnance	. .	. .	. .	1973	1976	1984	. .	Self-propelled version of FH-70
16	Germany, FR/ Switzerland	Gepard	AAV	Krauss-Maffei/Contraves	65	550	44	1966	1968	1973	. .	Arms: 2x35mm gun; Swiss designation: Caesar
16	Germany, FR/ USA	FSCV	SPG	Krauss-Maffei/FMC	61	400	14	. .	1979	. .	. .	Fire support combat vehicle based on M-113 chassis; ready for production
9	India	T-72	MBT		80	500	41	. .	. .	. .	. .	Licence agreement with the USSR of 1980
			TG		. .	. .	. .	. .	. .	1980	. .	Recent development; 105mm
		Mk-1 75mm	TG		. .	. .	. .	. .	. .	1980	. .	Recent development
		Vijayanta	MBT	Avadi Company	48	480	41	. .	. .	1965	. .	British Vickers MBT built under licence agreement of 1961
7	Ireland		AC	Technology Investments	. .	. .	. .	. .	1980	. .	. .	New AC under development; arms: 90 or 105mm gun
		Timoney	APC	Technology Investments	100	900	9	1972	1973	1974	. .	Also produced in Belgium as the BDX
		Timoney	LT	Technology Investments	80	. .	13	. .	1980	. .	. .	Under development

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
8 Israel	M-68 155mm	TH	Soltam	..	21	8	..	..	..	..	Based on Finnish M-60 122mm field gun
	M-71 155mm	TH	Soltam	..	23	9	..	..	1980	..	Development of the M-68
	Merkava-1	MBT	IMI	..	..	58	1969	1977	1978	1978	
	Merkava-2	MBT	IMI	..	..	..	1977	..	..	..	Development; arms: 120mm gun; R&D partly financed by the USA
	RAM V-1	Rcccc AC	RAMTA	95	850	3	..	1979	1980	..	Successor of RBY Mk-1 recce AC; versions incl AAV, RL and anti-tank
	RBY-1	Rcccc AC	RAMTA	100	550	3	...	..	1975	..	Can be fitted with TOW
	Shoet Mk-2	APC	Nimda	90	400	9	1977	..	1980	1981	For recce and security missions
		SPG	Soltam	..	..	14	..	..	1980	..	Based on Centurion MBT chassis; ready for pro-duction; 155mm
4 Italy	IAFV	ICV	OTO-Melara	64	550	11	..	..	..	..	Based on M-113-A1; in service only with Italy
	Lion	MBT	OTO-Mclara	65	600	40	..	..	1973	..	Licence agreement with FR Germany of 1970; first order completed in 1978; additional order for some 120 more placed
	M-113-AI	APC	OTO-Melara	67	483	9	..	..	1965	..	Licence agreement with the USA of 1963
	Model 56 105mm	TH	OTO-Melara	..	13	1	..	1955	1957	..	In service with 27 armies
	OF-24 Tifone	MICV	OTO-Melara	70	500	18	..	1975	..	..	Based on MOWAG Tornado; not yet in production
	OF-40	MBT	OTO-Melara	60	600	40	..	1980	1981	..	Arms: 105mm gun; similar to Lcopard-1 MBT; being delivered to United Arab Emirates
		SPH	OTO-Melara	..	..	46	..	..	..	..	New Italian 155mm SPH mounted on OF-40 chassis; 225 on order for 2 non-NATO countries
	Type 6614	APC	Fiat/OTO-Melara	96	700	7	1969	..	..	..	Also being licence-produced in South Korea

		Type 6616	AC	Fiat/OTO-Melara	100	700	7	1970	1972	..	..	
10	Japan		AAV		..	..	..	1978	..	..	..	Under development; probably 2x35mm Oerlikon cannon on M-61 MBT chassis
		Type 73	APC	Mitsubishi	60	300	13	1967	1970	1973	..	Amphibious
		Type 74	MBT	Mitsubishi	53	300	38	1964	1969	1973	..	Arms: 105mm gun and MGs; production rate: 48/year
		Type 75 155mm	SPH	Mitsubishi	47	300	25	1969	1972	1976	..	Similar to M-109-A1
10	Korea, South	Type 6614	APC		96	700	7	..	..	1977	..	Licence agreement with Italy of 1976
9	Pakistan		LT		..	..	..	1979	..	..	..	Licence agreement with China of 1978
5	Poland	OT-64	APC	Polish State Arsenal	94	710	12	1959	..	1964	..	Jointly developed by Czechoslovakia and Poland
		T-72	MBT	Polish State Arsenal	80	500	41	..	..	1979	..	Licence agreement with the USSR of 1978; T-54/55 factory converted to production of T-72
4	Portugal	Chaimite	APC	Bravia	99	804	7	..	..	..	..	In production since the 1960s; similar to Cadillac Gage V-series
		Commando Mk-3	APC	Bravia	110	600	4	..	1977	..	..	Similar to Shorland
5	Romania	T-55	MBT	Romanian State Arsenal	..	..	..	..	..	..	..	Local modification of T-55 with Chieftain-style side skirts and a new AA-gun on the turret; more than 100 produced
		TAB-70	APC	Romanian State Arsenal	55	400	10	..	..	1970	..	Probably licence-produced version of BTR-60PB; in production; more recent model designated TAB-72
13	South Africa	Eland-2	AC	Sandock-Austral	..	..	5	..	..	1977	..	Local development of AML-60/90; probably in production
		Ratel	ICV	Sandock-Austral	105	..	15	..	..	1975	1977	Also designated Honey

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
	Safire	APC	Hotline Fire Equipment	. .	. .	1	1980	. .	. .	. .	Anti-riot vehicle under development
7 Spain	AMX-30	MBT		65	600	36	. .	. .	1974	. .	Licence agreement with France of 1974
	BMR-600	ICV	ENASA	100	900	13	1972	1975	1979	. .	In production for Spanish Army
7 Sweden	FH-77 155mm	TH	Bofors	. .	22	11	1968	1973	1975	1978	Export version designated FH-77B now in production
	Ikv 91	LT/TD	Hagglund & Sons	69	550	16	1965	1969	1972	1975	Arms: 90mm gun with laser rangefinder and 2 MGs
	Type 701	AAV	HB Utveckling AB	. .	. .	. .	. .	1981	. .	. .	Missile AAV; first prototype delivered 1981 for evaluation; based on S-103 MBT chassis
7 Switzerland	Grenadier	APC	MOWAG	100	550	4	. .	. .	. .	. .	Amphibious
	MOWAG Gepard	TD	MOWAG	70	500	19	. .	. .	1971	. .	Designed for export; arms: 90mm gun
		MBT	Contraves/Fed. Constr. Works	. .	. .	40	1975	. .	. .	. .	Joint development of new Swiss MBT; Leopard-2 may be chosen instead
	Piranha	APC	MOWAG	100	700	7	. .	. .	. .	. .	Designed in the early 1970s; wide range of roles such as recce, ARV, anti-tank and AAV; also produced under licence in Canada and Chile
	Pz-68	MBT	Federal Construction Works	55	300	40	. .	1968	1968	1971	Development of Pz-61; variants: ARV, BL and AAV
	Pz-68 AAG	AAV	Contraves	50	300	43	. .	1979	. .	. .	AAV-version of Pz-68 MBT; not yet in production; arms: 2x35mm Oerlikon cannon
	Roland	APC	MOWAG	110	550	3	1961	. .	. .	. .	For internal security missions; unconfirmed reports of licence

												production in Latin America (Argentina)
		Taifun	TD	MOWAG	. .	. .	. .	1980	. .	. .	. .	Being developed; based on MOWAG Gepard TD and Tornado MICV; arms: 105 or 120mm gun
		Tornado	MICV	MOWAG	70	600	17	1967	1968	. .	. .	
4	UK	AT-105	APC	GKN Sankey	96	510	8	. .	1974	1976	. .	
		Centaur	APC	Laird(Anglesey)	80	. .	6	1977	1978	1980	1980	Multi-role half track vehicle
		Challenger	MBT	Royal Ordnance	. .	. .	60	. .	. .	1980	. .	Development of Shir-2; arms: 120mm gun; fitted with Chobham armour; to replace Chieftain
		Chieftain ARV	ARV	Vickers	42	322	52	. .	. .	1976	. .	Pull capacity: 90t
		Chieftain BL	BL	Vickers	. .	. .	53	. .	. .	1974	. .	Bridge-span: 22-23m
		Chieftain-3	MBT	Vickers/Royal Ordnance	48	500	54	1958	1959	1962	1963	Arms: 120mm gun; now built at Vickers for export only
		Chieftain-5	MBT	Vickers/Royal Ordnance	48	500	55	1958	1959	1962	1963	Still in production for export
		Fox FV-721	AC	Royal Ordnance	104	434	5	1965	1967	1972	1973	Production as required
		Khalid	MBT	Royal Ordnance	. .	. .	. .	. .	. .	. .	. .	In production for Jordan; upgraded version of Shir-1 with laser sight
		MBT-3	MBT	Vickers	56	600	39	. .	. .	1966	. .	In production for Kenya
		MBT-3 ARV	ARV	Vickers	. .	. .	36	. .	. .	. .	. .	6 built for Kenya
		MBT-80	MBT	Royal Ordnance	. .	. .	. .	1978	1980	. .	. .	Development temporarily cancelled in favour of FV-4030/3 Challenger
		MCV-80	MICV	GKN Sankey	75	. .	. .	. .	. .	. .	1985	Project definition completed
		Samson FV-106	ARV	Alvis	72	483	8	. .	. .	1977	1978	Scorpion series
		SB-301	APC	Short Brothers	96	368	3	. .	1973	1974	. .	
		Scimitar FV-107	Recce AC	Alvis	80	644	7	. .	1971	1973	1974	Arms: 30mm gun; Scorpion series
		Scorpion 90	LT/TD	Alvis	73	644	7	. .	. .	. .	. .	Upgraded version of FV-101 with 90mm Cockerill gun improving anti-tank capability
		Scorpion FV-101	LT	Alvis	80	644	7	1964	1969	1970	1972	Arms: 76mm gun and 7.62mm MG

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
	Shir-2	MBT	Royal Ordnance	. .	. .	. .	. .	. .	. .	. .	Production suspended due to cancellation of Iranian order for 1 225 MBTs
	Shorland	AC	Short Brothers	88	257	2	. .	1965	1965	. .	
	Spartan FV-103	APC	Alvis	87	644	8	. .	. .	1977	1978	Also available in AAV and anti-tank versions; Scorpion series
	Stormer	APC	Alvis	72	800	10	. .	1981	. .	. .	New tracked APC based on FV-4333 experimental vehicle; Scorpion development; to enter US Marine Corps LAV competition
	Striker FV-102	TD	Alvis	72	483	8	. .	. .	1974	1975	Tracked anti-tank version of Scorpion FV-100 series
	Sultan FV-105	CPC	Alvis	72	483	8	. .	. .	1976	1977	Scorpion series
		TG	Royal Ordnance	. .	17	1	1966	1973	1973	. .	105mm
	Valiant	MBT	Vickers	60	600	43	. .	. .	1980	. .	For export; arms: 105mm gun; Chobham armour
16 UK/Italy/ Germany, FR	FH-70 155mm	TH	Vickers/OTO-Melara/ Rheinmetall	. .	30	9	1968	1971	1976	1978	New European field howitzer now entering service
1 USA	AIFV	MICV	FMC	61	480	12	. .	1970	1978	. .	In service with Netherlands and the Philippines
	Commando Ranger	APC	Cadillac Gage	112	482	4	1977	. .	1979	. .	In production for US Air Force
	Commando Scout	Recce AC	Cadillac Gage	96	800	6	. .	1977	1978	. .	
	DIVADS	AAV	Ford Aerospace	. .	. .	. .	. .	1980	. .	. .	Based on M-48-A5 chassis; Ford won order for new AAV-system after competition with General Dynamics; arms: 2x40mm Bofors AAG
	Dragoon 300	APC	Hagan/Arrowpointe	122	724	9	. .	1978	1979	. .	Designed for export
	Hydracobra	APC	Bell	95	600	11	. .	. .	. .	. .	Bell proposes to build under licence from Engesa of Brazil; version of EE-11 Urutu with 90mm gun

LVTP-7A1	Amph ASSV	FMC	..	..	..	..	..	1977	..	Improved version of LVTP-7; programme incl conversion of original version as well as new production version
M-1 Abrams	MBT	Chrysler	72	450	53	..	1978	1980	..	New standard US Army MBT
M-106-A1	APC	FMC	67	483	11	..	..	1970	..	Mortar carrier version of M-113-A1; 107mm mortars
M-109-A1 155mm	SPH	Bowen-McLaughlin	56	390	19	1970	..	1972	..	Converted M-109s
M-109-A2 155mm	SPH	Bowen-McLaughlin	56	390	19	..	..	1978	..	Development of M-109-A1
M-113-A1	APC	FMC	67	483	9	..	..	1963	..	
M-113-A2	APC	FMC	..	..	..	..	1978	1979	..	Improved M-113-A1
M-125-A1	APC	FMC	67	483	10	..	..	..	..	Mortar carrier version of M-113-A1; 81mm mortars
M-163 Vulcan	AAV	FMC/General Electric	67	483	12	1964	..	1968	..	AAV version of M-113-A1
M-198 155mm	TH	Rock Island Arsenal	..	30	7	1968	1972	1978	..	
M-48-A5	MBT	Chrysler	48	482	44	1975	..	..	..	Modernized version of A1 and A3
M-548	APC	FMC	67	483	10	1960	..	1966	..	Cargo version of M-113 family; also the basis for Rapier, Hawk and Chaparral missile systems
M-577-A1	CPC	FMC	67	595	10	..	..	1962	..	CPC-version of M-113-A1
M-60-A3	MBT	Chrysler	48	500	44	..	1976	1978	..	
M-728	AEV	Chrysler	..	..	..	1963	1965	1968	..	Based on M-60-A1 chassis
M-88-A1	ARV	Bowen-McLaughlin	..	..	..	..	..	1976	..	In production for South Korea; upgraded version of M-88
M-901 TOW	APC	FMC	67	483	9	..	..	..	1979	Anti-tank version of M-113-A1; US Army requirement: 2 526
V-150 Commando	APC	Cadillac Gage	88	800	9	..	1971	1971	..	Latest version; exported to more than 20 countries; similar to Dragoon 300 and Chaimite APCs
V-300 Commando	APC	Cadillac Gage	88	640	13	..	1981	..	..	Will be produced in several versions
Wolverine	APC	Vought	..	..	..	1981	..	..	..	Based on AMX-10RC hull; arms: 105mm Rheinmetall gun; to enter US Marine Corps MPWS competition

Region code/ Country	Weapon designation	Weapon description	Manufacturer	Speed (km/hr)	Range (km)	Weight (t)	Year design begun	Year of first proto-type	First produc-tion year	Year entered service	Comments
	XM-2	MICV	FMC	66	483	18	..	1978	1981	1981	New MICV for US Army; to cooperate with M-1 MBTs; also in cavalry version designated XM3
	XR-311	Recce AC	FMC	108	483	2	1969	1971	..	..	Multi-mission combat support vehicle; ready for production
2 USSR	BMD	LT	Soviet State Arsenal	80	320	9	..	..	1969	1970	Arms: 76mm gun, MGs and Sagger ATMs
	BMP-1	MICV	Soviet State Arsenal	55	300	11	..	..	1967	..	Amphibious; latest version probably designated BMP-2; arms: 73mm gun, MG and ATMs
	BTR-70	APC	Soviet State Arsenal	..	..	..	..	..	..	1980	Development of BTR-60PB; first seen in military parade Nov 1980
	D-30 122mm	TH	Soviet State Arsenal	..	15	3	..	..	..	1960	
	M-1973 152mm	SPG	Soviet State Arsenal	50	500	25	..	..	1971	..	
	M-1974 122mm	SPH	Soviet State Arsenal	60	500	16	..	..	1971	..	
	M-46 130mm	TG	Soviet State Arsenal	..	12	4	..	1951	1952	..	Probably still in production
	MT-LB	APC	Soviet State Arsenal	61	400	11	..	..	1970	..	Multi-purpose tracked vehicle; probably still in production
	T-62	MBT	Soviet State Arsenal	45	450	40	..	..	1961	..	Predecessor of T-64/72; probably still in production
	T-64	MBT	Soviet State Arsenal	80	500	40	1962	..	1966	..	Early version of T-72 MBT
	T-72	MBT	Soviet State Arsenal	100	500	41	..	..	1972	1972	
	T-80	MBT	Soviet State Arsenal	..	..	..	..	1977	..	..	With Chobham-type armour
	ZSU-23-4 Shilka	AAV	Soviet State Arsenal	44	260	14	1961	..	1964	..	Based on PT-76 chassis
6 Yugoslavia	M-48 76mm	TG	Yugoslav. State Arsenal	..	8	..	1946	..	..	1947	Mountain gun probably still in production
	M-980	MICV	Yugoslav. State Arsenal	70	500	11	..	..	1975	..	Arms: 20mm gun and twin Sagger ATM launcher

6. The trade in major conventional weapons

Square-bracketed numbers, thus [1], *refer to the list of references on page* 189.

I. Introduction

There is at the present time little enthusiasm for any multilateral restraint of the international trade in arms. The CAT (Conventional Arms Transfers) talks between the United States and the Soviet Union have not resumed for the past three years, and the European arms suppliers have shown little, if any, inclination towards participating in multilateral restraint efforts. In the present climate of tense relations between the two great powers, this situation is unlikely to change in the near future. Furthermore, economic incentives, particularly in the West European arms manufacturing countries but also in the USA and the USSR, are becoming increasingly important. International tension (exemplified by recent events in Afghanistan, Poland, the Middle East and Central America), national economic considerations, and competitive fears of losing market shares all make the prospects for the control and eventual elimination of the global arms trade look bleak. Indeed, as one observer puts it:

> To oppose such a development may well place one in the role of an existentialist character, struggling against a fate he knows to be inevitable; but if the proliferation of conventional arms is an undesirable prognosis, it is perhaps the only basis for a critical moral stance. [1]

The flow of arms: general trends

The flow of arms during the period 1979–81 is shown in figures 6.1 and 6.2. (All the tables and figures in this chapter are based only on *actual deliveries* of major conventional weapons.) The Soviet Union has passed the United States as the world's largest major-weapon exporting country during the period (figure 6.1). This is partly due to a substantial increase in Soviet arms exports to India and to countries in the Middle East and North Africa, and partly to a decline in US exports mainly resulting from the policy of unilateral restraint initiated by President Carter in 1977.

The 1979–81 Third World share of total arms imports is approximately 62 per cent (figure 6.2), compared to a share of 69 per cent for the period 1977–80. The long-term trends in the arms trade with the Third World are shown in tables 6.1 and 6.2. The total value, measured in constant prices, for every five-year period has approximately doubled compared

Figure 6.1. Shares of world exports of major weapons, 1979–81, by country

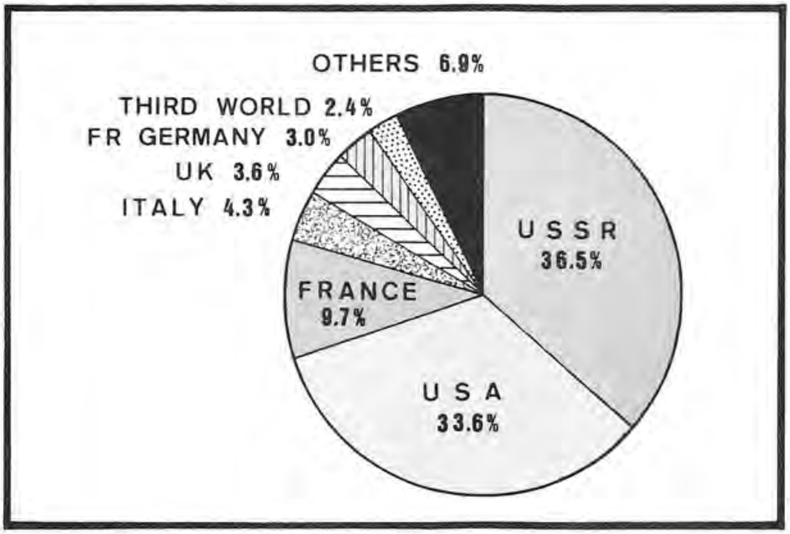
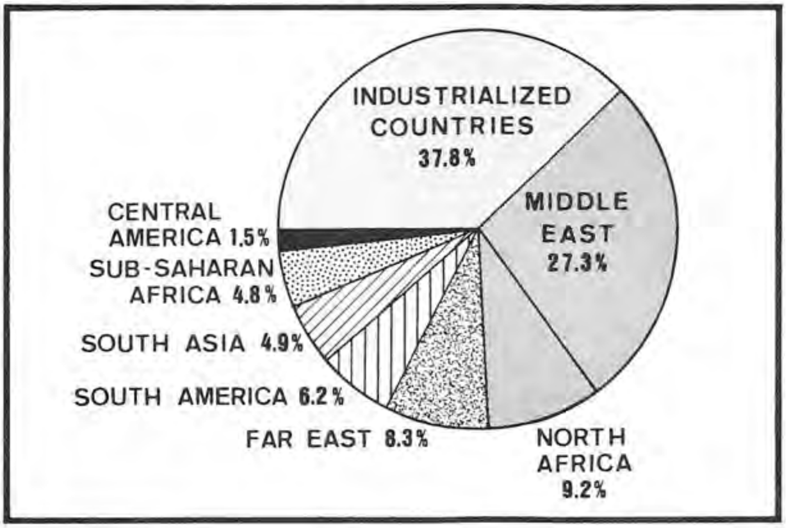


Figure 6.2. Shares of world imports of major weapons, 1979–81, by region



to the previous period. Among recipient areas, Africa has become more important. Among supplying countries, France and Italy have increased their share of total exports, and the UK share has fallen. (The growth of Third World arms imports on an annual basis is shown in figure 6.3.)

The increase in the world arms trade is both quantitative and qualitative. In the early 1960s, the vast majority of transferred weapons were relatively unsophisticated and second-hand. Today it is different. The current SIPRI arms trade registers—covering major weapons on order or being delivered in 1981—identify approximately 1 100 separate arms transfer agreements. Ninety-four per cent of these contracts are for new weapon systems, 2 per cent are for second-hand weapons, and 4 per cent are for refurbished weapons.

Table 6.1. Shares of imports of major weapons by the Third World: by region, 1962–81

Percentages are based on SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices.

Region[a]	1962–66	1967–71	1972–76	1977–81
Middle East	*28*	*46*	*51*	*44*
Africa	*15*	*9*	*16*	*24*
Far East	*31*	*27*	*15*	*13*
Latin America	*12*	*7*	*11*	*11*
South Asia	*14*	*11*	*7*	*8*
Total	*100*	*100*	*100*	*100*
Total value	**7 870**	**14 583**	**25 775**	**47 829**

[a] Regions are listed in rank order according to their shares for 1977–81.

Table 6.2. Shares of exports of major weapons to the Third World regions in table 6.1: by supplier, 1962–81

Percentages are based on SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices.

Country[a]	1962–66	1967–71	1972–76	1977–81
USA	*29*	*34*	*38*	*37*
USSR	*42*	*42*	*33*	*33*
France	*9*	*7*	*10*	*12*
Italy	*1*	*1*	*2*	*5*
UK	*12*	*10*	*9*	*4*
Others	*7*	*6*	*8*	*9*
Total	*100*	*100*	*100*	*100*
Total value	**7 870**	**14 583**	**25 755**	**47 829**

[a] Countries are listed in rank order according to their shares for 1977–81.

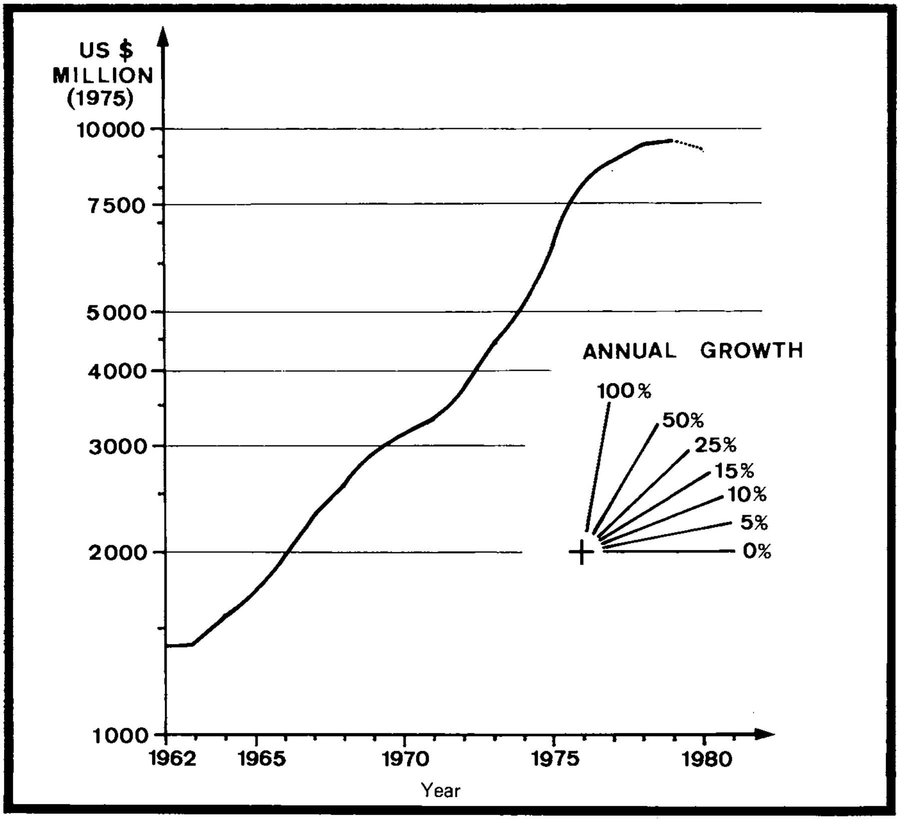
II. The suppliers

The United States

In May 1977, President Carter issued a directive outlining his policy on conventional arms transfers. The aim was to bring about a slowing-down in the international arms trade through a unilateral policy of US restraint, which in turn might lead the Soviet Union and other major suppliers to follow suit. Arms exports were only in exceptional cases to be used as

Figure 6.3. Imports of major weapons by the Third World, 1962–80

Based on five-year moving averages of SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices.



instruments of US foreign policy. The directive established a dollar ceiling for total US foreign military sales, and it indicated an intention not to introduce advanced weaponry that would significantly raise the combat capability in any given region. It restricted the resale of arms to third countries, and reaffirmed the link between human rights criteria and military assistance. Soon after this directive was issued, negotiations with the Soviet Union were begun on conventional arms transfers.

This was a praiseworthy attempt to curb the international trade in arms, but unfortunately it failed. Neither the Soviet Union nor West European arms suppliers were prepared to co-operate in a multilateral effort of restraint. Furthermore, from the very beginning, and particularly during 1979–80, the Carter Administration made several exceptions to its stated policy. A gap emerged between this policy and actual arms sales decisions.

A new policy

The restraints which remained were seemingly eliminated on 8 July 1981, when President Reagan signed a new Presidential Directive on arms transfers. The guidelines in this directive stem from the same philosophy that lies behind the rearmament programme described in the previous chapter: fundamental US interests are challenged by the Soviet Union and the stability in many regions considered vital to the USA is being threatened.

The following excerpt from the directive indicates the new attitude:

> The United States cannot defend the free world's interests alone. The United States must, in today's world, not only strengthen its own military capabilities, but be prepared to help its friends and allies to strengthen theirs through the transfer of conventional arms and other forms of security assistance. Such transfers complement American security commitments and serve important United States objectives. Prudently pursued, arms transfers can strengthen us. The United States therefore views the transfer of conventional arms and other defence articles as an essential element of its global defence posture and an indispensable component of its foreign policy . . . We will deal with the world as it is, rather than as we would like it to be. [2]

At this stage, the Reagan guidelines are more in the nature of a repeal of the Carter policy than the elaboration of a new one. The Directive consists of a broad set of aims and principles rather than a specific set of rules. One thing, however, is made clear: the human rights issue is dead. The directive states than an important factor to be considered when making arms transfer decisions is "whether any detrimental effects of the transfer are more than counterbalanced by positive contributions to United States interests and objectives" [2].

The Reagan guidelines are basically a restatement of Republican advocacy in the early 1970s of the policy for arming Third World countries as a substitute for US military presence there. The so-called Nixon doctrine implied that the USA should help its friends and allies among the developing countries to help themselves. Measures to this effect, apart from cash sales, arms-for-oil agreements and so on, will be carried out through an extensive programme of military and economic assistance. The security assistance authorization for FY 1982 shows an increase of 30 per cent compared with FY 1981. Almost 70 per cent of the programme is intended for the Middle East; the bulk of it is allocated to Israel and Egypt. Other major recipients in the North Africa–Middle East area include Morocco, Somalia, Tunisia and North Yemen. A substantial part of the total security assistance consists of Foreign Military Sales (FMS) financing. To facilitate arms exports through the FMS programme, a number of changes have been proposed. A Defence Acquisition Fund will be established in order to procure equipment in anticipation of the requirements of allied and friendly nations. It is argued that this will minimize the damage to US force readiness that results from the diversion of US service stocks. It is also proposed to raise by a factor of two the reporting thresholds to Congress for transfers of weapons and other defence equipment [3].

It is perhaps not surprising that the Reagan Administration is more disposed than the Carter Administration to use arms sales as an instrument of foreign policy. The political arguments are coupled with economic ones. It is far cheaper, and less politically troublesome, to send arms abroad than to send US troops. A US soldier in Egypt, for example, would cost $150 000 a year, while an Egyptian soldier costs $2 100 a year [4]. Furthermore, arms transfers improve the foreign trade balance, provide some 800 000 jobs in the USA, and make US domestic arms procurement cheaper.

What is notable, however, is the Administration's tendency to consider arms transfers almost exclusively in an East–West context. A typical example of this is the wish to supply arms to several mutually hostile parties in the Middle East in an effort to contain Soviet penetration of the Gulf region. Such an approach may underestimate the driving forces underlying regional conflicts and may instead fuel local rivalries and arms races.

Applications of the policy

In January 1980, President Carter made a substantial exception to his declared policy when he allowed the production of a fighter aircraft, the FX, designed solely for export. The new Reagan guidelines also call for the production of equipment that more readily fits the needs of Third World countries in terms of cost and complexity. In practice, however, this principle has been undermined during 1981 by a number of decisions that imply dropping the distinction between first-class and second-class friends. The offer to sell 24 General Dynamics top-of-the-line F-16 fighters to Venezuela is one example of such a decision. Similarly, the long-standing request from South Korea to acquire new fighter aircraft has been approved by the Reagan Administration. At a cost of $900 million, South Korea will get an initial batch of 36 F-16s. This means the introduction into the region of weaponry of a significantly higher technological level than before, and it also means the risk of an intensified regional arms build-up. F-16s in the South Korean Air Force will probably induce the Soviet Union to provide North Korea with MiG-23 fighters. There is also the formidable $3.2 billion five-year military and economic aid package to Pakistan. The main item of this agreement is 40 F-16 fighters—possibly with some funding from Saudi Arabia—of which six will be delivered in 1981–82 by diverting European-produced F-16s to the US Air Force.

The package also includes attack helicopters, tanks, anti-tank missiles, artillery, armoured personnel carriers and advanced communications systems. Pakistan is considered part of the strategic line against the USSR that also includes the pro-Western Gulf states, Egypt, Israel and Turkey. In return, the United States is concerned to gain access to airfields and ports for the Rapid Deployment Force. The argument has also been put forward that the military aid package will help to prevent Pakistan from acquiring nuclear weapons.

Another notable example of a military assistance undertaking during 1981 is the US participation—together with Saudi Arabia, Egypt, Pakistan and China—in a clandestine operation to supply arms to the Afghan resistance. The weapons, mainly Soviet or replicated Soviet equipment from Egypt, include surface-to-air and anti-tank missiles as well as rifles and machine-guns [5]. Other recipients of significant US military assistance during 1981 include Egypt, El Salvador, Israel and Sudan. Furthermore, a request from the Administration for resumption of arms sales to Argentina and Chile has been approved by the Congress; this was previously prohibited because of human rights violations.

Two particular issues have come to the fore during 1981 in connection with US arms export policy. These are possible sales of arms to China and the $8.5 billion sale of five Boeing E-3A AWACS aircraft and other equipment to Saudi Arabia. During the Carter Administration it was decided that so-called dual-use technology and certain defence-related material would be made available to China. Some 400 export licences, including the export of electronics and military support equipment, were also granted to US companies. Very few, if any, of these sales were actually made. Then, in June 1981, US Secretary of State Haig said that the USA was willing to consider selling 'lethal' weapons to China on a case-by-case basis and in consultation with the Congress and allied countries. Restrictions on sales of military-related technology would also be drastically reduced. Among the weapons the USA is willing to sell are Hawk surface-to-air missiles, TOW anti-tank missiles and armoured personnel carriers. It is doubtful, however, if this offer will result in a major inflow of US weapons. China is wary of major foreign weapon purchases for a number of reasons. First, its financial resources are limited; defence has at present a relatively low priority and the emphasis on self-reliance in defence modernization means that China would rather buy fire control systems to improve the accuracy of existing tanks and missile systems than invest in advanced fighter aircraft it cannot manufacture. Second, the purchase of US weapons would create pressure on China to accept the sale of FX or even F-16 fighters to Taiwan as a *quid pro quo*.

From a US point of view this is a delicate question. The harsh Chinese attack on the Netherlands, including downgraded diplomatic relations, after the sale of two Dutch submarines to Taiwan obviously made an impression. Compromises are possible, but the conclusion is that the United States will continue to deliver defence-related technology rather than actual weapon systems. The so-called 'China card' is a powerful foreign policy instrument only so long as it is not played.

The AWACS sale is something altogether different. The agreement is perhaps the most important US arms transfer ever in terms of the money, the technology and the implications involved. Apart from the five AWACS surveillance and battle management aircraft, this air defence package comprises six KC-135 aerial refuelling tankers, 1 177 AIM-9L Sidewinder air-to-air missiles for 62 F-15 fighters already on order, long-range fuel tanks for the F-15s and 22 ground-based radar installations, 10 of which will operate with the AWACS planes. The opposition to this sale in the USA has centred around three arguments: first, the threat it poses to Israel; second, the risk that the sensitive technology could be revealed to the Soviet Union; and third, the risk that the identification of the Saudi regime with the US government might strengthen the position, within Saudi Arabia, of opponents of the existing Saudi government. The latter argument implies a development similar to that in Iran.

The Administration argues in favour of the deal on the grounds that it helps Saudi Arabia defend its oilfields against strike attacks from the Soviet Union or from pro-Soviet countries such as South Yemen or Ethiopia. It is also argued that the deal will help to restore US credibility as a reliable security partner; that the whole apparatus of training, logistics, support infrastructure, and so on increases US military presence in the region; and that the whole air defence system will be compatible with the equipment of US forces, thus facilitating the deployment of US soldiers and weapons to the region in time of need. Given the historical Saudi opposition to foreign military bases on their soil, the AWACS deal is the nearest thing to a prepositioned base structure that the USA is likely to obtain at the present stage. And, apart from the obvious fact that it is a cash sale that may lower the procurement cost for the US Air Force's own AWACS planes, this is the heart of the matter. Both the present and the previous US Administrations have, in co-operation with Saudi Arabia, been trying to create an integrated regional air defence system of US origin, led by Saudi Arabia. Defence collaboration within the recently formed Gulf Cooperation Council—including Saudi Arabia, Oman, Qatar, Bahrain, the United Arab Emirates and Kuwait—may be a further step in that direction. In its concentration on the East–West perspective, the US government has paid little attention to the possible alternative uses that Saudi Arabia might make of the package, to the internal consequences that might follow from the sale, and to the strong criticism of their closest ally in the region—Israel.

Other NATO

When an economy is in crisis, more weight is attached to economic than to political arguments. With high unemployment, foreign trade imbalances and budget deficits, this is now particularly evident in the West European arms manufacturing countries. Financial constraints have caused cuts, postponements and cancellations in most domestic defence procurement programmes. This has, in part, contributed to rising unit costs, thus inducing further cuts. For these reasons, the major arms producers are pushing military sales, particularly to Third World countries, more than ever before. Criticism is muted by strong national economic considerations: arms exports improve the balance of payments, lower unit prices through the advantages of scale, and ensure employment in the arms industries. As one French arms industry representative put it at the Satory defence exhibition: "if we don't export, in 20 years we'll be making propeller aircraft and wooden missiles" [6].

The French arms industry employs some 300 000 workers and is highly dependent on exports. More than 5 per cent of total French exports consist of weapons, and for the leading arms export company, the aircraft manufacturer Dassault-Breguet, exports constitute approximately 70 per cent of total turnover. French trade unions generally advocate arms exports for employment reasons and, together with the industry, they exert a major influence on public opinion and political decision makers. The attitude of French government officials towards arms exports is that it is up to the individual country to choose the weapons it will purchase; France should not interfere with the procurement policies of other countries by, for example, refusing to sell a certain weapon system. On the contrary, France should offer Third World countries a possibility to diversify their arms sources so that they need not become dependent on either the United States or the Soviet Union. The agreement with Nicaragua in December 1981—for two helicopters, two patrol boats and a training programme—illustrates this policy. Those in favour of restraint initially hoped that the Mitterand government would introduce a set of strict arms export regulations in accordance with campaign promises made. This, as it turned out, was not the case; the French government has evidently decided that the economic benefits which arms sales provide outweigh any moral arguments. However, 29 of 50 AMX-30 main battle tanks for Chile have recently been embargoed.

France exports weapons mainly to countries from which it receives something in return. In the year ending April 1981, the Middle East and North Africa took nearly 80 per cent of total French weapon sales [7]. In spite of the continuing war between Iran and Iraq, France delivered Mirage fighters to Iraq and missile-armed fast attack boats to Iran during

1981. Libya received weapons during much of 1981, with the exception of an export ban from February to July due to the Chad intervention. At the same time, France increased deliveries to the Central African Republic, Gabon, the Ivory Coast and Senegal in order to prevent Libyan aggression in these countries.

In the UK, arms exports provide jobs for 140 000 people and account for 2.5 per cent of all British exports [8]. The government regards arms exports as an important element in the eventual recovery of the British economy. Prime Minister Thatcher's April tour of the Middle East, following a visit to India, was the culmination of an intensive arms marketing effort conducted by strong British diplomatic and industrial teams. The main promotion item was the BAe Hawk, an advanced jet trainer/light strike aircraft. It is reported that the United Arab Emirates and Saudi Arabia soon afterwards signed contracts for 30 and 40 Hawks, respectively. Other British weapons destined for the Gulf states are Chieftain tanks and Rapier surface-to-air missiles. However, the British government has refused—despite reported requests from both sides—to supply arms or spare parts to Iraq or Iran while they are at war [9].

In July 1980, the government lifted the embargo on arms sales to Chile, which had been imposed in 1974 for human rights violations. During 1981, this resulted in a much criticized agreement to sell a missile destroyer of the County-class and a 27 000-ton fleet tanker to the Chilean Navy. Both ships were made redundant as a result of cuts in the Royal Navy surface fleet. The sale was defended by government officials on the grounds that the two ships could hardly be used in a counter-insurgency role [10].

In FR Germany there are problems of financing future defence outlays while at the same time the greater part of the West German arms industry is working at 50 per cent of capacity [11]. The question is whether FR Germany will openly follow France, the UK and Italy in their effort to export arms for economic reasons. The sale of two Kiel-Howaldtswerke Type 209 submarines to Chile has reportedly been stopped and the submarines have been offered to Denmark, but a large sale of armoured vehicles to Saudi Arabia is still pending. In order to go through, this deal —for Leopard tanks, Gepard anti-aircraft vehicles and Marder infantry combat vehicles—will require a substantial change in FR Germany's arms export policy. The policy of prohibiting sales to 'areas of tension', for example, will have to be revised.

An indication of the possible outcome of the deal was the approval by the federal government in October 1981 of the British sale of the sophisticated FH-70 towed howitzer to Saudi Arabia; this howitzer is jointly produced by the UK, FR Germany and Italy [12]. Several French–West German weapon systems, such as HOT, MILAN and Roland missiles and

Alpha Jet trainer/strike aircraft, are currently being sold world-wide under French arms export laws.

In recent years, Italy has emerged as the world's fourth largest exporter of major weapon systems after the United States, the Soviet Union and France. This boom is not entirely due to the quality of Italian weaponry. The export surveillance scheme enables firms to export to virtually any country in the world. The lack of government control over Italy's arms manufacturers is one of the aspects of the trade most strongly criticized inside and outside the country. The weapons exported include indigenously designed light warships, such as Lupo-class frigates, corvettes and fast patrol boats; missiles and aircraft as well as licence-produced helicopters of US design; and armoured vehicles from the USA and FR Germany. Italy's arms transfers are almost exclusively to Third World countries, with Libya as the single largest recipient.

The Soviet Union

The Soviet Union was the world's largest supplier of major weapon systems during the period 1979–81 (figure 6.1). However, the USSR still has a smaller number of customers than the USA, and it is less willing than the USA to allow licensed production of their major weapons. According to the SIPRI arms trade registers covering major weapons on order or in the process of delivery during 1981, the Soviet Union has current arms deals with 28 countries, while the corresponding figure for the United States is 67 countries. Furthermore, the registers identify 61 US major weapons being produced under licence outside the USA, while the Soviet Union has only 10 similar arrangements: these are with Czechoslovakia, Poland and India.

Soviet arms exports are otherwise guided by the same political and economic motives as those of the United States. Arms transfers serve as a means of establishing a presence in regions important to the Soviet Union or to counter Western interests. Military sales and assistance often provide the opening wedge for a variety of other contacts which would otherwise have been difficult to achieve. An arms agreement with a developing country has been the point of departure for most Soviet advances in the Third World, beginning with the first Soviet arms deal negotiated with Egypt in 1955–56.

One attractive feature of Soviet military assistance from a Third World point of view has traditionally been low prices and favourable credit terms. The prices charged have naturally varied with the type and quality of the equipment, but Soviet prices have on the whole been lower than Western prices for comparable equipment. Credits have usually been made available at a 2 per cent interest rate and a 10-year credit period [13]. This situation has been changing during the past couple of years.

The USSR has recently faced some difficulties in sustaining such terms for military aid because of its declining economy; has increasingly had to seek hard currency payments for its military equipment; and since 1977, has often required a substantial cash down payment. In the case of recent jet fighter sales to Zambia, it offered only seven years credit at commercial rates. [14a]

As with Western arms suppliers, the Soviet Union needs arms exports as a way of lowering domestic procurement costs. Sales for hard currency have almost entirely supplanted the favourable terms of earlier years, especially when the clients are oil-producing countries such as Algeria, Iraq or Libya. One result of this may be the diversion of domestic stocks for export purposes. It is believed that the surprisingly slow introduction into service of the T-72 main battle tank in the WTO armies is partly explained by large exports to Libya, Syria and other oil-producing countries in the Middle East and North Africa.

Officially, the USSR refused to supply either side in the Iran–Iraq war during 1981. In spite of this, Soviet equipment found its way to both antagonists through countries allied to the Soviet Union. Poland delivered more than 100 (some sources report 300) T-55 tanks to Iraq, while North Korea reportedly shipped Soviet weapons to Iran [14b]. It is also possible that the Israeli air raid on the nuclear reactor in Baghdad made the USSR

Table 6.3. Rank order of the 20 largest Third World major-weapon importing countries, 1979–81

Percentages are based on SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices.

Importing country	Percentage of total Third World imports	Importing country	Percentage of total Third World imports
1. Libya	*9.0*	11. Peru	*2.7*
2. Saudi Arabia	*8.9*	12. Algeria	*2.6*
3. Iraq	*7.7*	13. South Korea	*2.5*
4. Syria	*7.3*	14. Argentina	*2.2*
5. Israel	*6.8*	15. Indonesia	*2.0*
6. India	*5.1*	16. Cuba	*1.7*
7. South Yemen	*3.9*	17. Thailand	*1.6*
8. Egypt	*3.9*	18. Chile	*1.6*
9. Viet Nam	*3.7*	19. Kuwait	*1.6*
10. Morocco	*2.8*	20. Taiwan	*1.5*
		Others	*20.9*
		Total	*100.0*
		Total value[a]	**25 971**

[a] Values include licence production.

Source: SIPRI data base.

resume direct deliveries of spare parts and arms to Iraq, although this has not been confirmed. Kuwait and Jordan, the latter a traditional client for US weapons, are two other Middle East countries opting for Soviet military equipment, mainly surface-to-air missiles.

In South Asia, it is likely that the US decision to sell F-16 fighters to Pakistan will trigger new arms deals between India and the Soviet Union —deals that will be in excess of the $1.6 billion arms credit package concluded between the two countries in 1980. In Afghanistan, the USSR has introduced MiG fighters, Mi-24 Hind helicopter gunships and numerous infantry fighting vehicles in the war against the resistance, but no major weapons are being transferred to Afghan government forces, which are apparently regarded as unreliable. In Central America, Cuba received during 1981 MiG-21/23 fighters, T-62 tanks, a Koni-class frigate and other equipment.

The Soviet Union has, together with other major arms suppliers, been faced with the prospect that the recipients might use their weapons for purposes not congruent with the intentions of the supplier. However, the Soviet Union is using arms transfers as an important instrument for maintaining and expanding its influence in the Third World. Arms transfers play a far greater role than economic aid or trade in this respect; it is virtually the only area in which they have successfully rivalled the West.

Third World suppliers

Arms exporting countries in the Third World can be divided into two categories: those which export domestically produced weapons, whether indigenously designed or produced under licence (notably Brazil, Israel, South Africa, India and Argentina), and those which re-export arms originally purchased from the industrialized countries (for example Egypt, Libya and Saudi Arabia). The Third World share of the global trade in major conventional weapons is comparatively small, 2.4 per cent for the period 1979–81, but it is a growing share (see figure 6.1 and table 6.4). Third World countries also export large quantities of small arms. Third World arms producers sell arms mainly for economic reasons. Because of lower unit prices—made possible by lower production costs—it is above all other Third World countries that buy these weapons. Political preferences are of lesser importance: "We're looking to the Third World, and we'll sell to the right, the left and the center", says one Brazilian government arms sales director [15].

Brazil has a booming arms industry. The Engesa company reportedly sells approximately 1 000 armoured vehicles a year to 32 countries, mostly on arms-for-oil terms to OPEC members in Africa and the Middle East. Brazilian rifles and machine-guns are in service in Angola and Congo.

Table 6.4. Rank order of the six largest Third World major-weapon exporting countries, 1979–81

Percentages are based on SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices.

Exporting country	Percentage of total Third World export
1. Brazil	*45.6*
2. Israel	*21.1*
3. Libya	*12.3*
4. South Korea	*8.2*
5. Egypt	*6.2*
6. Saudi Arabia	*1.6*
Others	*5.0*
Total	*100.0*
Total value	**993**

Source: SIPRI data base.

The Avibras company sells, among other things, air-to-ground missiles to Iraq, and Embraer markets a wide range of aircraft including jet trainers, counter-insurgency aircraft and transports. In 1981 Brazil started deliveries of the Xingu trainer/light transport jet to the French Air Force.

In 1979 Israel reportedly sold arms of a total value of $600 million, a figure that rose to $1.2 billion in 1980 [16]. Israel produces the Kfir jet fighter, Shafrir and Gabriel missiles, the Merkava tank and Reshef missile boats, several of which have been sold to South Africa. It is, however, mainly through exports of defence electronics, small arms and ammunition that Israel has reached its position as one of the world's leading arms exporters. More than 300 000 rounds of 105-mm HEAT (high-explosive anti-tank) tank ammunition has been sold, including a $40 million deal concluded with Switzerland in September 1981. The Galil rifle is another prominent export item; 10 000 are now being supplied to the Guatemalan Army under an agreement worth $6 million [17]. The most conspicuous Israeli arms transfer during 1981 is the sale to Iran of ammunition, refurbished jet engines, spare parts for US-built M-48 tanks and tyres for F-4 Phantom fighters. Some of these items were shipped from Tel Aviv to Teheran by a British private arms dealer in an Argentine aircraft via Larnaca Airport in Cyprus [18]. It is also, incidentally, via this airport that the French Mirage F-1 fighters are being ferried to Iraq.

Other Third World deliveries to Iran during 1981 include 190 Soviet-built T-54/55/62 tanks, artillery shells and more spares for the M-48s from Libya. Egypt has, on the other hand, provided Iraq with $25 million worth of military equipment delivered via Oman [19]. Other recipients of weapons from Egypt include Chad, Somalia, Sudan and the Afghan resistance. Sudan has also been receiving a number of old US tanks, probably M-41s and M-47s, from Saudi Arabia [20].

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Appendix 6A

Aggregate tables of the value of the trade in major weapons with the Third World, 1962–81

Table 6A.1. Values of imports of major weapons by the Third World: by region, 1962–81[a]

Figures are SIPRI trend indicator values, as expressed in US $ million, at constant (1975) prices. A = yearly figures, B[b] = five-year moving averages.

Region code	Region[c]		1962	1963	1964	1965	1966	1967	1968	1969
8	Middle East	A	574	393	388	441	440	1 063	1 258	1 212
		B	342	398	447	545	718	883	1 087	1 351
10	Far East (excl Viet Nam)[d]	A	356	310	392	340	497	199	266	586
		B	404	320	379	348	339	378	364	348
12	North Africa	A	39	34	40	81	122	135	83	87
		B	28	42	63	82	92	102	110	110
13	Sub-Saharan Africa (excl S. Africa)	A	47	47	68	95	93	81	55	71
		B	51	63	70	77	78	79	84	92
15	South America	A	109	72	51	110	138	128	208	158
		B	124	109	96	100	127	148	156	173
9	South Asia	A	189	221	79	213	391	271	297	312
		B	209	198	219	235	250	297	314	336
14	Central America	A	298	96	34	18	21	16	8	10
		B	139	131	93	37	19	15	12	17
	South Africa	A	16	155	51	186	92	78	45	46
		B	46	82	100	112	90	89	68	63
11	Oceania	A	–	–	–	–	–	–	–	–
		B	–	–	–	–	–	–	–	–
	Total (excl Viet Nam)[d]	A	**1 628**	**1 328**	**1 104**	**1 485**	**1 794**	**1 971**	**2 220**	**2 482**
		B	**1 344**	**1 344**	**1 468**	**1 536**	**1 715**	**1 990**	**2 195**	**2 490**
	Viet Nam	A	75	56	91	74	237	494	473	298
		B	65	74	107	190	274	315	387	427
	Total[e]	A	**1 703**	**1 384**	**1 195**	**1 559**	**2 031**	**2 465**	**2 693**	**2 780**
		B	**1 409**	**1 418**	**1 574**	**1 726**	**1 989**	**2 305**	**2 582**	**2 917**

[a] The values include licensed production of major weapons in Third World countries (see appendix 6D). For the values for the period 1950–56, see *SIPRI Yearbook 1976*, pp. 250–51; and for 1957–61, *SIPRI Yearbook 1978*, pp. 254–55.
[b] 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.
[c] The regions are listed in rank order according to their average values for 1979. The region code numbers in the first column correspond to those used in the arms trade registers (appendices 6B and 6C).
[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.
– Nil.

Source: SIPRI computer-stored data base.

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1 462	1 758	1 076	2 211	2 836	3 527	3 613	5 190	4 438	2 950	4 507	3 957
1 353	1 544	1 869	2 282	2 653	3 475	3 921	3 944	4 140	4 208	–	–
271	419	162	302	249	640	1 035	653	2 381	2 074	879	514
341	348	281	354	478	579	992	1 357	1 404	1 300	–	–
121	123	167	145	228	761	929	948	1 461	1 460	1 288	1 070
116	129	157	285	444	602	865	1 112	1 217	1 245	–	–
121	134	89	152	386	232	432	1 148	1 429	326	815	655
94	113	176	199	258	470	725	713	830	875	–	–
148	222	310	352	446	630	710	826	808	983	945	679
209	238	296	392	490	593	684	791	854	848	–	–
300	499	409	289	373	177	414	663	1 030	585	643	797
363	362	374	349	332	383	531	574	667	774	–	–
6	47	35	56	87	137	58	60	250	74	223	342
21	31	46	72	75	80	118	116	133	190	–	–
77	69	25	37	274	179	118	211	365	133	49	20
52	51	96	117	127	164	229	201	175	156	–	–
–	–	–	–	–	–	3	–	3	–	1	2
–	–	–	–	–	–	–	–	–	–	–	–
2 506	**3 272**	**2 273**	**3 545**	**4 878**	**6 284**	**7 312**	**9 699**	**12 165**	**8 585**	**9 350**	**8 036**
2 551	**2 816**	**3 295**	**4 050**	**4 858**	**6 344**	**8 068**	**8 813**	**9 422**	**9 567**	–	–
433	435	1 200	82	185	20	–	–	–	–	–	–
568	490	467	384	–	–	–	–	–	–	–	–
2 939	**3 707**	**3 473**	**3 627**	**5 064**	**6 304**	**7 312**	**9 699**	**12 165**	**8 585**	**9 350**	**8 036**
3 118	**3 305**	**3 762**	**4 435**	**5 156**	**6 401**	**8 109**	**8 813**	**9 422**	**9 567**	–	–

Table 6A.2. Values of exports of major weapons to regions listed in table 6A.1: by supplier, 1962–81[a]

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

Country[b]		1962	1963	1964	1965	1966	1967	1968	1969
USA[c]	A	368	514	372	540	514	481	754	1 244
	B	472	437	462	484	533	707	850	983
USSR[c]	A	1 029	429	375	544	970	1 545	1 116	834
	B	512	578	669	773	910	1 002	1 120	1 229
France[c]	A	121	194	137	96	140	68	288	172
	B	110	120	138	127	146	153	174	201
Italy	A	1	20	20	7	1	20	67	53
	B	10	10	10	14	23	30	37	49
UK	A	124	177	179	265	193	203	294	348
	B	195	197	188	203	227	261	245	285
FR Germany	A	2	13	26	13	83	4	11	17
	B	15	12	27	28	27	26	23	12
Netherlands	A	3	*	11	22	1	–	5	25
	B	4	8	7	7	8	11	8	15
China[c]	A	–	–	51	9	47	17	5	10
	B	43	12	21	25	26	18	20	32
Canada[c]	A	3	13	11	18	12	11	48	19
	B	13	13	11	13	20	22	25	34
Sweden	A	*	–	–	–	2	–	–	*
	B	–	–	–	–	–	–	–	1
Czechoslovakia	A	6	16	9	4	8	11	39	22
	B	19	8	9	10	14	17	22	23
Switzerland	A	–	2	–	1	1	1	1	–
	B	–	1	1	1	1	1	1	1
Japan[c]	A	24	1	1	6	11	30	49	2
	B	8	9	9	10	19	20	18	16
Third World	A	10	4	3	4	25	15	9	20
	B	5	5	9	10	11	15	15	13
Other industrialized, West	A	2	1	*	30	23	58	7	11
	B	2	7	11	22	24	26	20	25
Other industrialized, East	A	11	*	–	*	–	2	–	2
	B	2	2	2	–	–	1	1	2
Total[d]	A	**1 703**	**1 384**	**1 195**	**1 559**	**2 301**	**2 465**	**2 693**	**2 780**
	B	**1 410**	**1 418**	**1 574**	**1 727**	**1 989**	**2 305**	**2 581**	**2 917**

[a] The values include licences sold to Third World countries for production of major weapons (see appendix 6D). For the values for the period 1950–56, see *SIPRI Yearbook 1976*, pp. 252–53; and for 1957–61, *SIPRI Yearbook 1978*, pp. 256–57.
[b] The countries are listed in rank order according to their average values for 1979.
[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.

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1 258	1 179	1 166	1 061	1 404	2 343	3 892	4 826	5 244	2 046	2 794	2 670
1 120	1 182	1 214	1 431	1 973	2 705	3 542	3 688	3 760	3 516	–	–
1 136	1 515	1 225	1 537	1 930	2 160	1 554	2 156	3 682	3 631	3 774	2 420
1 615	1 249	1 469	1 673	1 681	1 867	2 296	2 637	2 959	3 133	–	–
203	276	351	538	449	593	553	1 282	1 236	879	1 008	1 220
258	308	363	441	497	683	823	908	992	1 125	–	–
43	41	52	56	139	72	159	348	553	549	516	383
51	49	66	72	96	155	254	336	425	470	–	–
185	393	369	316	579	647	587	536	488	453	431	226
318	322	368	461	500	533	567	542	499	427	–	–
1	25	37	3	116	138	131	60	87	230	159	283
18	17	36	64	85	90	106	129	133	164	–	–
10	34	27	39	33	42	29	72	64	169	103	59
20	27	29	35	34	43	48	75	87	93	–	–
22	106	158	27	104	63	57	66	142	26	73	147
60	65	83	92	82	63	86	71	73	91	–	–
37	55	39	6	1	6	34	29	117	28	17	39
40	31	28	21	17	15	37	43	45	46	–	–
–	–	5	1	6	21	21	5	5	51	85	18
1	2	7	6	11	11	12	21	33	33	–	–
31	14	14	1	15	6	6	–	18	45	45	22
24	16	15	10	8	6	9	15	23	26	–	–
2	2	2	2	*	1	8	5	6	25	23	25
1	2	2	1	3	3	4	9	13	17	–	–
*	*	–	–	3	–	3	–	14	21	–	–
10	–	1	1	1	1	4	7	7	7	–	–
8	15	18	20	276	185	202	134	394	338	249	385
14	16	67	103	140	163	238	251	263	300	–	–
3	46	11	19	11	13	46	162	110	62	27	106
16	18	18	20	20	50	68	79	81	93	–	–
–	5	–	–	–	2	30	18	5	32	46	33
1	1	1	1	6	10	11	17	26	27	–	–
2 939	**3 707**	**3 473**	**3 627**	**5 064**	**6 304**	**7 312**	**9 699**	**12 165**	**8 585**	**9 350**	**8 036**
3 118	**3 305**	**3 762**	**4 435**	**5 156**	**6 401**	**8 109**	**8 813**	**9 422**	**9 567**	–	–

Appendix 6B

Register of the arms trade with industrialized and Third World countries, 1981

This appendix lists major weapons on order or under delivery during 1981. (Note: Statistics in chapter 6 are for actual deliveries only.) The sources and methods for the data collection, and the conventions, abbreviations and acronyms used, are explained in appendix 6D. The entries are made alphabetically, by recipient, supplier and weapon designation.

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
I. Industrialized countries								
11 Australia	France	1	Durance Class	Support ship	1977			For delivery 1983; total cost: $68 mn
		(248)	R-550 Magic	AAM	1981			Replacing obsolete Sidewinders on Mirage fighters
	New Zealand	14	CT-4 Airtrainer	Trainer	(1980)	1981	7	
						(1982)	(7)	
	UK	2	SH-3D Sea King	Hel	(1980)			For delivery 1983
	USA	. .	AGM-84A Harpoon	AShM	(1981)			Arming 10 P-3C Orion on order from the United States
		4	F-111	Fighter/bomber	1980			For delivery in 1982; 4 more may be ordered as attrition aircraft
		75	F-18A Hornet	Fighter/strike	1981			Selected after competition with F-16
		1	FFG-7 Class	Frigate	1980			For delivery 1984
		3	FFG-7 Class	Frigate	1976	1981	2	Total cost incl all 3 ships; unit cost expected to be $190-230 mn
		36	M-198 155mm	TH	1980			Order incl support equipment; to enter service in 1983
		10	P-3C Orion	ASW/mar patrol	1981			In addition to 20 P-3B/Cs in service; armed with Harpoon AShMs
		90	RGM-84A Harpoon	ShShM	1976			30 launchers ordered for 2 FFG-7 Class and 3 Perth Class frigates; may buy 30 more
7 Austria	France	24	Mirage-50	Fighter/MRCA	(1981)			Decided in principle; other sources report choice of F-16 still possible
4 Belgium	Brazil	5	EMB-121 Xingu	Transport	1980	1981	5	

	France	6000	MILAN	ATM	1979			Offset order from Euromissile; total requirement: 240 systems
		40	SA-361 Dauphin	Hel	(1980)			Negotiating
	USA	(1224)	AIM-7E Sparrow	AAM	1977	1979	(60)	Arming 104 F-16 fighters
						1980	(120)	
						1981	(216)	
		(200)	AIM-9L	AAM	1980	1981	(100)	Arming F-16s
		..	MIM-23B Hawk	Landmob SAM	(1979)			To replace 2 battalions of MIM-23A
5 Bulgaria	USSR	..	MiG-23	Fighter	(1978)	1979	(20)	
						1980	(20)	
						1981	(20)	
		..	T-72	MBT	(1978)	(1980)	(50)	
						(1981)	(50)	
4 Canada	UK	..	Blowpipe	Port SAM	1981			
	USA	182	AIM-9L	AAM	1980			Ordered Sep 1980; arming F-18s
		..	B-747-200F	Transport	1980			For VIP use
		18	CP-140 Aurora	ASW/mar patrol	1976	1980	9	Special design for Canada based on P-3C Orion and S-2A Viking
						1981	9	
		138	F-18A Hornet	Fighter/strike	1980			Order incl 113 single-seat fighters and 24 two-seat operational trainers; delivery planned for 1983-89; Canadian designation: CF-18; total cost: $2 500-5 000 mn
		14	Model 206B	Hel	1980	1981	14	For pilot training
		21	Musketeer Sport	Lightplane	(1980)	1981	21	Also designated Sundowner
3 China	Argentina	..	TAM	MT	(1981)			Negotiating; possible order may incl VCI-type ICV
5 Czechoslovakia	USSR	..	AT-4	ATM	1979	(1980)	(480)	Seen during military parade
						1981	(480)	
		..	AT-6 Spiral	ASM	(1979)	1980	(24)	Seen on Mi-24 Hind-D helicopters; 2 missiles/hel
						1981	(24)	
		..	M-1974 122mm	SPH	1979	(1980)	(50)	Seen during military parade
						(1981)	(50)	
		..	Mi-24 Hind-D	Hel	(1979)	(1980)	(12)	In service
						1981	(12)	
		..	MiG-23	Fighter	(1977)	1978	(30)	Incl interceptor, ground attack and trainer versions
						1979	(30)	
						1980	(30)	
						1981	(30)	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		. .	SA-9 Gaskin	Landmob SAM	1979	(1980)	(200)	Seen during military parade
						1981	(200)	
4 Denmark	Germany, FR	2	Type 209	Submarine	(1981)			Negotiating; originally intended for Chile; also designated Type 210
	UK	1	Lynx	Hel	(1980)	1981	1	For maritime patrol; in addition to 7 delivered 1980
	USA	840	BGM-71A TOW	ATM	1980			DoD notified Congress; total cost incl 62 launchers
		46	F-16A	Fighter/strike	1977	1980	(13)	
						1981	(13)	
						(1982)	(13)	
		12	F-16B	Fighter/strike	1977	1980	3	
						1981	3	
						(1982)	(3)	
		3	Gulfstream-3	Transport	1979	1981	1	For maritime patrol, transport and SAR duties
						1982	2	
		(72)	MIM-23B Hawk	Landmob SAM	1981			2 btys with 12 launchers each
		15	RGM-84A Harpoon	ShShM	1980			Order incl support equipment; for 3 Niels Juel Class frigates
7 Finland	Sweden	(60)	Bv 206	APC	1980			Total cost: $3.75 mn
	UK	50	Hawk	Adv trainer	1977	1980	2	4 to be delivered complete from the UK, the rest scheduled for local assembly during 1981-85
						1981	(10)	
	USA	3	Learjet-35A	Transport	1980			
	USSR	(7)	An-32 Cline	Transport	1979			Unconfirmed
		8	Mi-8 Hip	Hel	1980	1980	(3)	Follow-on order to 6 in service; bought in spite of AF preferences for Western types
						1981	(5)	
		. .	SA-7 Grail	Port SAM	1978	(1980)	(25)	
						(1981)	(25)	
4 France	Brazil	41	EMB-121 Xingu	Transport	1981	1981	(8)	Ordered Jan 1981; planned delivery schedule: 1981-8, 1982-19, 1983-14; 25 for AF, 16 for Navy
						(1982)	(19)	
	Canada	2	DHC-6	Transport	(1979)	1981	2	Delivered Mar 1981
	UK	14	Lynx	Hel	1980			On order
	USA	5	E-2C Hawkeye	AEW	(1981)			Negotiating

		4	RIM-24 Tartar	ShAM	1980			Ordered Feb 1980; 4 systems
5 German DR	USSR	. .	AT-4	ATM	1978	(1979)	(240)	
						(1980)	(240)	
						1981	(240)	
		. .	M-1973 152mm	SPG	(1978)	1979	(20)	First shown in military parade Oct 1979
						(1980)	(50)	
						(1981)	(50)	
		. .	M-1974 122mm	SPH	(1979)	(1980)	(10)	In service
						(1981)	(10)	
		. .	MiG-23	Fighter	(1978)	1979	(12)	
						1980	(12)	
						1981	(12)	
		. .	Su-20 Fitter-C	Fighter/bomber	(1978)	1979	(10)	
						1980	(10)	
						1981	(10)	
		. .	T-72	MBT	(1978)	1979	(50)	
						1980	(100)	
						1981	(100)	
4 Germany, FR	Israel	4	Westwind 1123	Transport	1980			Ordered May 1980
	UK	12	Lynx	Hel	1979	1981	(2)	For 6 Type 122 frigates; some sources report 22 Lynx on order; first hel delivered Jun 1981
	USA	500	AGM-65B	ASM	(1981)			Arming F-4Fs; will probably also be ordered for Tornado MRCA
		762	BGM-71A TOW	ATM	1979			Agreement signed at Paris Air Show; to arm Bo-105 hel
		(96)	NATO Seasparrow	ShAM/ShShM	1977			NATO co-production programme group in 1977
		142	RGM-84A Harpoon	ShShM	1978			
		. .	Stinger	Port SAM	(1981)			In principle chosen as replacement for Redeye; looking for funding
4 Greece	Austria	. .	Cuirassier	LT/TD	(1980)			Undisclosed number ordered
		100	Steyr-4K 7FA	APC	1981			More to be ordered; partly built by Steyr-Hellas in Saloniki; Greek designation: Leonidas
	Germany, FR	(20)	F-104G	Fighter	(1980)	(1981)	(20)	NATO aid
		4	Leopard ARV	ARV	1981			
		102	Leopard-1-A4	MBT	1981			For delivery 1983-84; order incl 4 ARV units

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	Italy	..	Aspide	AAM/SAM/ShAM	1981			Arming Kortenaer Class frigates on order from Netherlands; will use Seasparrow fire control
		6	CH-47C Chinook	Hel	1980	1981	(2)	
						1982	4	
		20	G-222	Transport	(1981)			Unconfirmed
	Netherlands	(15)	F-27 Maritime	Mar patrol	(1980)			Negotiating 10-15 aircraft plus offset agreement
		1	Kortenaer Class	Frigatc	1981	(1982)	1	For delivery late 1982; in addition to 1 delivered in 1981; option for licence production of 2 more still open
		1	Kortenaer Class	Frigatc	1980	1981	1	
	Norway	100	Penguin-2	ShShM	1976	1980	(50)	Arming 6 Combattante-3 Class FACs being licence-produced in Greece
						(1981)	(50)	
	USA	200	AGM-65B	ASM	1980			DoD notified Congress; bringing AFs air-to-ground capability near to NATO minimum standards
		300	AIM-9L	AAM	1977			DoD notified Congress Jul 1980; arming A-7 Corsairs
		1487	BGM-71A TOW	ATM	(1981)			Total cost incl 50 launchers: $19 mn
		1	Gearing Class	Destroycr	1980	1981	1	
		144	M-101-A1 105mm	TH	1979			On order
		48	M-109-A2 155mm	SPH	1981			US Letter of Offer; total cost: $37 mn
		12	M-113-A2	APC	1980	1981	12	Total cost incl 10 M-728s
		10	M-728	AEV	1980			Total cost incl 12 M-113-A2s
		600	Chaparral	Landmob SAM	1979			Ordered Nov 1979; incl 37 launch vehicles
		8	Model 209 AH-1S	Hel	1980			Ordered Sep 1980; armed with TOW
		32	RGM-84A Harpoon	ShShM	1979			For Navy; incl support and equipment; pending congressional approval
5 Hungary	USSR	(40)	MiG-23	Fighter	(1978)	1980	(15)	
						(1981)	(15)	
		..	T-72	MBT	1980	1981	(30)	Ordered Apr 1980
7 Ireland	France	(60)	M3	APC	(1979)	1980	(30)	
						(1981)	(30)	
		1	Model 172	Lightplane	(1979)	1981	1	
		1	SA-330 Puma	Hel	(1980)	1981	1	On lease for 18 months; delivered Jul 1981

		1	SA-342L Gazelle	Hel	(1980)	1981	1	
	Sweden	..	RBS-70	Port SAM	1979	1980	(50)	Ordered Dec 1979; reportedly in service
						1981	(50)	
	UK	16	Scorpion FV-101	LT	(1978)	(1980)	(8)	
						(1981)	(8)	
4 Italy	France	(3252)	MILAN	ATM	1981			Italy plans to procure 37 750 missiles; the remainder will be produced under licence by OTO-Melara over a 10-year period; order incl 1 850 launchers of which 250 will be purchased directly from Euromissile
	Germany, FR	..	AS-34 Kormoran	AShM	1980			Arming IAF Tornados
	USA	2211	BGM-71A TOW	ATM	1981			First sale of improved version; order incl 632 practice missiles
		1	C-9B Skytrain-2	Transport	1980			
		2	RIM-24 Tartar	ShAM	(1980)			DoD notified Congress; 2 systems arming Audace Class destroyers
		35	RIM-67A/SM-1	ShAM/ShShM	1981			Replacing Terrier on 1 hel cruiser and 2 Andrea Doria Class cruisers and augmenting Tartar on Audace- and Impavido Class destroyers
		..	S-76 Spirit	Hel	(1980)	1981	(4)	Acc to Sikorsky first hel delivered May 1981
10 Japan	USA	..	AGM-84A Harpoon	AShM	(1980)			Decided to buy for P-3C Orion instead of Mitsubishi ASM; funding in FY 1980 budget; Navy also wants shipborne version
		(168)	AIM-7F Sparrow	AAM	(1981)			
		171	AIM-9L	AAM	1981			Arming F-4 and F-15 fighters; licence production to follow
		..	C-130H Hercules	Transport	1981	1981	(2)	6 on order; total requirement: 14
		4	E-2C Hawkeye	AEW	1979			For delivery early 1983
		4	E-2C Hawkeye	AEW	1981			Additional batch of 4 to be delivered 1984-85
		12	F-15A Eagle	Fighter/interc	1977	1981	6	To be delivered prior to licence production of 86
		16	King Air C-90	Trainer	(1979)	1980	2	Incl in $13 000 mn modernization
						1981	(4)	programme for 1980-84
		87	M-113-A2	APC	1980			Ordered Jan 1980
		3	P-3C Orion	ASW/mar patrol	1977	1981	(1)	To be delivered prior to licence
						(1982)	(2)	production of 42; first aircraft delivered Jun 1981

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		(32)	RGM-84A Harpoon	ShShM	(1981)			2 quadruple launchers on 2 new destroyers now under construction in Japan; further orders likely
		(8)	RIM-24 Tartar	ShAM	(1981)			Arming new destroyer now under construction
		(900)	Stinger	Port SAM	(1981)			14 sets on order for delivery in FY 1981-82
		13	Super King Air	Transport	(1979)			For maritime patrol
4 Netherlands	Germany, FR	445	Leopard-2	MBT	1979			Contract signed Jun 1979; chosen instead of US XM-1; offsets to Netherland industry at 59% of purchase value, may reach 100%; to replace 369 Centurions and 130 AMX-13s
	UK	12	Lynx	Hel	1980			In addition to 24 in service
	USA	12	AGM-84A Harpoon	AShM	(1978)			
		840	AIM-9L	AAM	1977	1979	(40)	Arming 102 F-16 fighters
						1980	(160)	
						1981	(240)	
		86	M-109-A2 155mm	SPH	1978			
		37	M-110-A2 203mm	SPH	1980			Ordered Jul 1980
		144	M-198 155mm	TH	1980			On order
		13	P-3C Orion	ASW/mar patrol	1978	1981	1	For delivery 1982-84 at a rate of 4/year; Update-2 version; can carry Harpoon AShMs
						(1982)	(4)	
		288	RGM-84A Harpoon	ShShM	1975	1978	24	For 12 Kortenaer Class frigates
						1979	(24)	
						1980	(48)	
						(1981)	(48)	
		..	RIM-24 Tartar	ShAM	1981			2 systems on order for 2 new frigates
		..	RIM-66A/SM-1	ShAM/ShShM	(1978)			
		1000	Seasparrow	ShAM/ShShM	(1981)			Pentagon intends to sell to a NATO consortium composed of the Netherlands, Belgium, Denmark, Norway and FR Germany
		646	Stinger	Port SAM	1981			
11 New Zealand	UK	2	Leander Class	Frigate	1981			
		26	Scorpion FV-101	LT	1980			On order

	USA	3	B-727	Transport	(1981)	1981	3	
		3	Model 421C	Trainer	1980	1981	3	Ordered Nov 1980
4 Norway	Germany, FR	(10)		Submarine	1981			Design contract signed for 750-900t patrol subs with IKL in Luebeck
	Sweden	16	MFI-15 Safari	Lightplane	1981	1981	16	Replacing old Safir trainers
		..	RBS-70	Port SAM	1981			Additional order for unspecified number
		..	RBS-70	Port SAM	1980	1980	(15)	Unspecified number delivered
						1981	(15)	
	UK	6	Lynx	Hel	1978	1981	6	For Coast Guard
	USA	432	AIM-9L	AAM	1977			NATO co-production programme; production started Dec 1980 at Raufoss; also production of rocket engine for NATO Sidewinder; formal contract signed Mar 1981
		60	F-16A	Fighter	1977	1980	(6)	To be delivered from licence production
						1981	(16)	in the Netherlands
		12	F-16B	Fighter/trainer	1977	1980	(2)	First delivered Jan 1980
						1981	(4)	
		20	M-113-A2	APC	1981			Deal incl modernization of 40 M-48 MBTs
5 Poland	USSR	..	M-1973 152mm	SPG	(1979)	(1980)	(30)	In service
						(1981)	(30)	
		..	M-1974 122mm	SPH	(1979)	(1980)	(30)	In service
						(1981)	(30)	
4 Portugal	Brazil	..	EE-11 Urutu	APC	(1981)			Negotiating
		..	EE-9 Cascavel	AC	(1981)			Negotiating
	Italy	12	A-109 Hirundo	Hel	1980			4 to be armed with TOW
	Netherlands	1	Kortenaer Class	Frigate	1981			On order; to be delivered prior to licence production of 2
	USA	20	A-7P Corsair-2	Fighter	1980	1981	(1)	Second country to receive A-7P version;
						1982	(19)	totally refurbished; payment: cash, MAP; delivery to start end-1981; Portugal may order a second squadron
		1	C-130H Hercules	Transport	(1980)			
		(20)	F-5E Tiger-2	Fighter	(1981)			Uncertain due to possible order for more A-7Ps instead
5 Romania	France	4	SA-365N	Hel	(1980)			

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
7 Spain	France	6	Mirage F-1B	Trainer	1976	1978	2	
						1979	2	
						(1981)	(1)	
						(1982)	(1)	
		22	Mirage F-1C	Fighter/interc	(1978)	(1981)	(11)	Also designated F-1E
						(1982)	(11)	
		6	SA-330L Puma	Hel	1978	1979	3	
						1981	3	
	Germany, FR	60	Bo-105CB	Hel	1979	1980	20	60 new to be delivered 1980-82: 28 as anti-tank hel with 6 HOT ATMs each, 14 as recce, 18 as armed recce; last 50 to be assembled by CASA
						(1981)	(20)	
		8	Bo-105CB	Hel	1981			In addition to 60 on order
		(168)	HOT	ATM	1979	1980	(60)	Arming 28 Bo-105CB hels; delivery from 1980
						1981	60	
	Italy	4	AB-212ASW	Hel	(1980)	1981	4	
		. .	Aspide/Albatros	ShAM/ShShM	1979			For installation in second batch of new F-30 Class frigates; number ordered unknown
		3	SH-3D Sea King	Hel	(1980)			On order; probably from Italy
	UK	6	SH-3D Sea King	Hel	(1980)	1980	3	
						1981	3	
	USA	3000	BGM-71A TOW	ATM	1978			
		6	C-130H Hercules	Transport	(1980)			On order in addition to 10 in service
		3	CH-47C Chinook	Hel	1980			For Army; in addition to 9 in service; for delivery 1982
		24	DHC-4 Caribou	Transport	(1980)			
		4	KC-130H	Transport	(1974)	1976	3	
						1981	1	
		204	M-113-A2	APC	(1978)			Order incl M-577 and M-125 vehicles
		36	M-125-A1	APC	1979			
		8	M-577-A1	CPC	1979			
		1760	Chaparral	Landmob SAM	1981			
		8	P-3C Orion	ASW/mar patrol	(1978)	(1979)	(4)	First 2 are version A
						(1980)	(2)	
						1981	2	
		(128)	RGM-84A Harpoon	ShShM	1978	1978	16	Arming 4 F-30 Class frigates
						1979	32	
						1980	16	

						1981	48	
						(1982)	(16)	
		..	RIM-67C/SM-2	ShAM/ShShM	(1981)			Arming 3 new FFG-7 Class destroyers now under construction
		..	Seasparrow	ShAM/ShShM	1976	1979	(24)	For 4 F-30 Class frigates; 1 octuple Selenia Albatross launcher/ship with 16 reload missiles
						1980	(24)	
						1981	(24)	
						(1982)	(24)	
		18	SH-60B Seahawk	Hel	1981			US agreed in principle; first export order
7	Sweden	Norway	16	Hugin Class	FAC	1975	1978	3	Deliveries to be completed in 1982; armed with Penguin ShShMs
						1979	5	
						1980	2	
						(1981)	(5)	
						1982	1	
		96	Penguin-1	ShShM	1975	1978	18	Arming 16 Hugin Class FACs
						1979	30	
						1980	12	
						1981	30	
						1982	6	
	UK	12	Lynx	Hel	(1981)			For Air Force; follow-on order of 25 for Army expected; offset contracts for 25% of order value offered by Westland
		(312)	Sky Flash	AAM	1978	1980	(64)	Ordered Dec 1978; arming new JA-37 Viggen
						1981	(128)	
		..	Sky Flash	AAM	1981			Additional quantity for JA-37 Viggen; total cost approx. $22 mn
	USA	..	AGM-65A	ASM	(1979)	1980	(64)	Arming JA-37 Viggen
						1981	(64)	
		(624)	AIM-9L	AAM	1978	(1980)	(64)	Arming JA-37 Viggen
						1981	(64)	
		2000	BGM-71A TOW	ATM	1980	1981	(500)	DoD notified Congress Oct 1980; total cost incl 100 practice missiles and associated equipment
		5	C-130H Hercules	Transport	1980	1981	5	2 separate orders; all delivered 1981
		3	Learjet-35A	Transport	(1980)			For delivery 1982
		..	MIM-23B Hawk	Landmob SAM	(1978)			
7 Switzerland	Austria	..	Steyr-4K 7FA	APC	1981	1981	(20)	Will buy undisclosed number; probably to be partly built by Mowag
	France	2	Mirage-3D	Trainer	1980			To replace 2 trainers lost in recent years; also designated Mirage-3BS/80

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	USA	(500)	AGM-65A	ASM	(1981)			Negotiating; arming F-5E fighters
		(288)	AIM-9L	AAM	1977	1977	(48)	
						1978	(76)	
						1979	(48)	
						1980	(48)	
						1981	(68)	
		1000	AIM-9P	AAM	1980			
		11790	Dragon FGM-77A	ATM	1978	1980	(6000)	Order incl 3 210 practice missiles
						(1981)	(5790)	
		2	M-1 Abrams	MBT	1980	(1981)	2	Delivered Jul 1981 for evaluation
		207	M-109-A2 155mm	SPH	1979			
		225	M-113-A1	APC	1979	1980	(100)	Order approved by Parliament autumn 1979
						(1981)	(125)	
		160	M-548	APC	1979			Order approved by Parliament autumn 1979
4 Turkey	Belgium	3	F-104G	Fighter	1981	1981	3	
	Denmark	23	F-100D	Fighter	1981	1981	23	Probably for spares
	Germany, FR	21	F-104G	Fighter	1980	1981	21	NATO aid; further deliveries will follow when FR Germany starts taking delivery of its Tornados
		(4)	Leopard ARV	ARV	1980	1981	(2)	NATO aid; for delivery 1981-83
						1982	(2)	
		200	Leopard-1-A3	MBT	1980	1981	(27)	Up to 190 Leopard MBTs and some 2 500 MILAN ATMs ordered from FR Germany in $350 mn aid package over 3 years
						1982	(54)	
		(2500)	MILAN	ATM	1981	1981	480	
	Italy	12	AB-212	Hel	1980	1980	(6)	Option on 6 more
						1981	(6)	
	Netherlands	(55)	F-104G	Fighter	1980	(1981)	(30)	Dutch Defence Minister announced; will be sold as they are; replaced 1980 by F-16; in Turkey replacing F-102s acc to Swedish embassy in Ankara
						(1982)	(25)	
	Norway	14	F-104G	Fighter	1981	1981	14	From NATO surplus stocks
	USA	400	AIM-9J	AAM	1978	1979	(100)	Ordered Aug 1978
						1980	(100)	
						1981	(100)	
		..	BGM-71A TOW	ATM	(1979)			Unspecified number on order
		15	F-4E Phantom	Fighter	1981			Letter of Offer announced Apr 1981

		200	M-48 Patton	MBT	1980			
		15	Model 205 UH-1H	Hel	1981			Total cost incl spares and support equipment: $32 mn
		12	RGM-84A Harpoon	ShShM	1980			Pending congressional approval
4 UK	France	120	MM-38 Exocet	ShShM	1975	1975	12	For 6 Amazon Class frigates and 4 Broadsword Class destroyers
						1976	12	
						1977	36	
						1978	12	
						1979	12	
						1980	12	
						(1981)	(12)	
	USA	1709	AIM-9L	AAM	1977			NATO co-production programme
		66	AV-8B Harrier	Fighter	1981			Selected after competition with Harrier Mk-5; the final agreement between BAe and McDonnell-Douglas covers 336 Harriers for the US Marines and 66 for the RAF; first UK delivery in 1984
		33	CH-47D Chinook	Hel	1978	1980	(3)	
						1981	(9)	
		18	M-109-A2 155mm	SPH	1980			Total cost incl 3 M-578s; some sources state ordered number 51
		3	M-578	ARV	1980			
		(100)	Trident-1	SLBM	(1981)			
1 USA	France	90	SA-366 Dolphin	Hel	1981			For Coast Guard; for delivery 1982-86; version of SA-365 Dauphin-2
	UK	47	Allday Marine	PC	1981			In addition to 102 ordered 1980
		102	Allday Marine	PC	1980	1980	(4)	Combat support ships
						1981	(20)	
		1	Lyness Class	Support ship	1980	(1981)	1	Fleet repl ship
		(128)	Rapier	Landmob SAM	1981			Offset for Trident SLBM; for defence of US air bases in the UK; delivery to start in 1983; 32 launch units with 4 missiles/launcher
2 USSR	Czechoslovakia	..	L-39 Albatross	Trainer	1972	1978		Replacing L-29 Delfin
						1979		
						1980		
						1981		
	Finland	2	Dubna Class	Tanker	1977	1979	1	
						1981	1	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
6 Yugoslavia	Canada	4	CL-215	Amphibian	1980			Ordered Jun 1980; not known whether bought for civil or military use
	France	2	Falcon-50	Transport	(1980)	1980	1	For VIP and military use
						1981	1	
	Norway	..	Penguin-2	ShShM	(1981)			Negotiating
	Switzerland	9	PC-6 Porter	Transport	1981			First delivery scheduled for 1982
	USA	13	Model 206B	Hel	(1979)			For police duties
	USSR	60	SSN-2 Styx	ShShM	1975	1977	6	Arming 10 Type 211 FACs
						1978	6	
						1979	12	
						1980	(12)	
						1981	(12)	

II. Third World countries

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
12 Algeria	USA	6	C-130H Hercules	Transport	1981			Due to relaxation of US arms export ban to Algeria
	USSR	..		FAC	1980			Contract signed Jul 1980; missile FAC; number unknown
		2	Koni Class	Frigate	(1977)	1981	1	First delivered Jan 1981; ship named 'Mourad Rais'
		..	T-62	MBT	1977	1979	31	
						1980	50	
						(1981)	(100)	
		(500)	T-72	MBT	(1979)	1979	(31)	First shown in military parade Nov 1979
						1980	(50)	
						(1981)	(50)	
13 Angola	Netherlands	1	F-27 Maritime	Mar patrol	1980	1981	1	Delivered Jan 1981 in addition to 1 delivered Jan 1980
	USA	2	L-100-20	Transport	(1980)			
	USSR	..	M-1974 122mm	SPH	(1979)	(1980)	(50)	In service
						(1981)	(50)	
		..	SA-2 Guideline	Landmob SAM	1979	1980	(20)	Recently installed acc to South African intelligence; SA-6 also reportedly deployed in Southern Angola
						1981	(20)	

		..	SA-6 Gainful	Landmob SAM	(1979)	1980 1981	(27) (27)	SA-2 and SA-6 sites in Angola destroyed prior to South African attack Aug-Sep 1981
15 Argentina	Austria	57	Cuirassier	LT/TD	1981	1981	57	Originally intended for Chile; order incl spares and ammunition
	France	1	A-69 Class	Frigate	1979	1981	1	New construction; in addition to 2 delivered 1979; originally purchased by South Africa but embargoed; delivered Jun 1981; ship named 'Granville'
		36	ERC-90 Lynx	AC	1979			Ordered Oct 1979; for border defence against Chile
		60	ERC-90S Sagaie	AC	1981			
		1000	HOT	ATM	1980	1980 (1981)	(200) (200)	Being delivered
		(6)	MM-38 Exocet	ShShM	1979	1981	(6)	Arming 1 A-69 frigate
		24	OTOMAT-2	ShShM	(1979)			Arming 6 Meko-140 frigates
		(80)	Roland-1	Landmob SAM	1981			4 btys to be mounted on TAM MTs
		12	SA-315B Lama	Hel	1978			For Army Air Wing
		12	SA-330J Puma	Hel	1978			
		3	SA-330J Puma	Hel	1980	1981	3	An additional 12 on order
		14	Super Etendard	Fighter/ASW	1979	1981 (1982)	(6) (8)	
	Germany, FR	4	Meko-360	Destroyer	1979	1981	1	
		2	Type 148	FAC	(1979)			On order from Lurssen
		2	Type 1700	Submarine	1977			To be delivered prior to licence production of 2
	Israel	16	Mirage-3C	Fighter	1981	1981	(16)	In addition to 26 delivered in 1980
	Italy	9	A-109 Hirundo	Hel	1977			For Army
		48	Aspide/Albatros	ShAM/ShShM	(1979)			Arming 4 Meko-360 destroyers
		10	MB-339A	Trainer/strike	1980	1981	10	
	Netherlands	(2)	F-27 Mk-400	Transport	(1980)	1981	2	
	Spain	5	B-119 Type	PC	1979			On order for Coast Guard; with hel platform; displacement: 900t
	UK	..	Blowpipe	Port SAM	1981			Unspecified number on order
		8	Lynx	Hel	1979	1981 (1982)	(4) (4)	To be delivered over next 3 years; for ASW; in addition to 2 in use; total cost: $3 mn
		..	Tigercat	Landmob SAM	1981			Unspecified number on order
	USA	1	Learjet-35A	Transport	1980	(1981)	1	Delivered May 1981
		1	Metro-2	Transport	(1979)			Pending congressional approval; for ambulance use; delivery held up by US arms export embargo

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
8 Bahrain	Francc	110	M3	APC	(1977)	(1978)	(30)	
						(1979)	(30)	
						(1980)	(35)	
						(1981)	(15)	
		24	MM-38 Exocet	ShShM	1980	(1981)	(24)	Arming 2 TNC-45 FACs delivered from FR Germany
	Germany, FR	2	Type TNC-45	FAC	1980	1981	2	Ships named 'Al Riffa' and 'Hawar'
9 Bangladesh	China	48	F-7	Fighter	1980	(1981)	(48)	Unconfirmed
		36	T-59	MBT	(1980)	1980	(18)	
						1981	(18)	
	USA	2	Model 206L	Hel	(1981)	1981	2	
		. .	Model 212	Hel	(1980)	1981	(3)	Unspecified number delivered; 3 seen in transit through Singapore
	USSR	(2)	An-26 Curl	Transport	(1981)	1981	2	At least 2
14 Barbados	UK	6		FAC	1979	1981	1	
13 Benin	Libya	1	Falcon-50	Transport	(1981)	1981	1	Designation unconfirmed
15 Bolivia	Belgium	52	F-104A	Fighter	1981			
	Brazil	6	SA-315B Gaviao	Hel	1981	1981	(2)	Ordered Feb 1981; delivery started Dec 1981
						(1982)	(4)	
		12	T-25 Universal	Trainer	(1979)			Production line to be re-opened if contract is signed; requested for COIN use
	France	6	SA-315B Lama	Hel	(1979)	1981	6	
	Netherlands	7	F-27 Mk-400M	Transport	1979	1980	4	Embargo for last 2 aircraft lifted Mar 1981
						1981	(3)	
	Switzerland	20	PC-7	Trainer	1981	1981	(10)	In addition to 16 recently acquired
	USA	(10)	Model 207	Lightplane	(1980)	1980	(3)	
						1981	(7)	
13 Botswana	USSR	(100)	SA-7 Grail	Port SAM	(1981)	1981	(100)	
		(30)	T-55	MBT	(1981)	1981	(30)	Designation unconfirmed
15 Brazil	France	. .	AS-11	ASM	1972	1974	(144)	Arming Xavantes
						1975	(144)	
						1976	(144)	
						1977	(144)	

						1978	(144)	
						1979	(144)	
						1980	(144)	
						1981	(144)	
	Italy	..	Maestrale Class	Frigate	1980			On order; possibly for licence production
		12	Wadi Class	Corvette	1980			Co-production/licence agreement signed Jun 1980; deal incl Maestrale Class frigates and Sauro Class subs
	Korea, South	38	M-44 155mm	SPH	1981	1981	38	Designation unconfirmed
	UK	1	Wasp	Hel	1981	1981	1	Ex-Royal Navy
10 Brunei	Germany, FR	(6)	Bo-105C	Hel	1979	1981	6	
	UK	2	BN-2A Defender	Transport	(1979)			Planning to purchase, according to unofficial reports
		..	Rapier	Landmob SAM	(1980)			1 bty ordered; incl Blindfire radar; total cost: $82 mn
		3		PC	1979	1979	1	Ordered with Decca radar;
						1981	2	2 commissioned May 1980
		..	Sabre	ATM	1979			Contract signed early 1979
	USA	7	S-76 Spirit	Hel	1979	1981	7	
10 Burma	Australia	6	Carpentaria Class	FAC	1979			Ordered Feb 1979
	Italy	3	SF-260M	Trainer	(1981)	1981	3	Designation unconfirmed
	Switzerland	18	PC-7	Trainer	1979	1981	(18)	
	USA	6	Model 180	Lightplane	(1979)			Unconfirmed; 10 in service
13 Cameroon	Canada	2	DHC-5D Buffalo	Transport	1981			
	France	6	Alpha Jet	Trainer	1981			
		(24)	AS-12	ASM/AShM	1980			Ordered Dec 1980; arming 1 Gazelle hel
		1	P-48 Class	FAC	1981			For delivery Mar 1983
		2	SA-342K Gazelle	Hel	1980			Ordered Dec 1980
		2	SA-360 Dauphin	Hel	1980	1981	(2)	Ordered Dec 1980; VIP version
	Germany, FR	3	Do-28D-1	Transport	1981	1981	1	For maritime patrol; first delivered
						(1982)	(2)	Nov 1981
15 Chile	Brazil	10	Anchova Class	PC	1977	1980	(3)	
						1981	(7)	
		..	EE-11 Urutu	APC	1981	1981	(50)	Deal incl Sucuri TDs
		..	EE-17 Sucuri	TD	1981	1981	(40)	
		6	EMB-326 Xavante	Trainer/COIN	(1978)			Unconfirmed
		20	T-25 Universal	Trainer	(1979)			On order
	France	..	Alpha Jet	Trainer	(1980)			Negotiating; Fouga-90 also requested

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		(50)	AMX-30	MBT	(1980)	1981	(50)	Delivered by Liberian ship from Bordeaux Mar 1981
		..	R-440 Crotale	Landmob SAM	1981			Ordered Apr 1981; delivery withheld by Belgium at Brussels Airport; 6 firing units; part of $40 mn contract
		3	SA-330L Puma	Hel	1980	(1981)	(3)	
	Germany, FR	2	Type 209	Submarine	1980			Construction began in FR Germany Oct 1980 but export licence not yet granted
	Israel	6	Reshef Class	FAC	1979	(1979)	(2)	Unconfirmed; first pair supposedly
						(1980)	(2)	delivered in 1979; remaining 4
						(1981)	(2)	to be delivered 1980-81
	South Africa	6	Cactus	Landmob SAM	1980			May be identical with Crotale order
	Spain	12	C-101 Aviojet	Trainer/strike	1980	1981	(4)	Assembled in Chile; option on more
		2	F-30 Class	Frigate	1981			Ordered May 1981
	UK	1	County Class	Destroyer	1981	1982	1	Ship named 'HMS Norfolk'; arms: Exocet ShShMs, Seacat and Seaslug ShAMs, 2x115mm gun; embargo on arms exports to Chile lifted in 1980; deal incl 27 000t tanker 'Tidepool'
		4	MM-38 Exocet	ShShM	1981	1982	4	Arming County Class destroyer
		8	Seacat	ShAM/ShShM	1981	1982	8	Arming County Class destroyer
	USA	16	AGM-84A Harpoon	AShM	1981			Arming 2 F-30 Class frigates
		1	B-727	Transport	(1979)	1981	1	For VIP use
		..	PA-28 Cherokee	Lightplane	1980	1981	(6)	Assembled in Chile from Piper-supplied kits
		16	Seasparrow	ShAM/ShShM	1981			Arming 2 F-30 Class frigates
15 Colombia	Brazil	..	EE-9 Cascavel	AC	1981			Designation unconfirmed; Colombia recently signed contract for undisclosed number of ACs
	France	32	MM-40 Exocet	ShShM	(1980)			Arming 4 FS-1500 Class frigates on order from FR Germany
	Germany, FR	4	FS-1500 Class	Frigate	1980			Light frigates on order; for delivery 1982-83
	Israel	12	Kfir-C2	Fighter/bomber	1981			Armed with AAMs amd ASMs; first delivery Mar 1982
	Spain	..	C-212-200	Transport	(1981)			Negotiating
	UK	1	HS-748-2A	Transport	1980	1981	1	

		USA	10	A-37B Dragonfly	Fighter/COIN	(1980)			Unconfirmed
			(2)	C-130H Hercules	Transport	(1980)			Surplus; negotiating
			12	Model 205 UH-1H	Hel	1981	(1981)	12	
			..	Seasparrow	ShAM/ShShM	(1980)			On order; arming 4 FS-1500 Class frigates
			6	T-38 Talon	Trainer	(1980)			
13	Congo	Spain	3	Barcelo Class	PC	1981			Ordered May 1981
14	Cuba	USSR	..	BMP-1	MICV	(1980)	1981	(50)	Acc to US sources; unconfirmed
			1	Koni Class	Frigate	(1979)	1981	1	Designation unconfirmed
			(120)	MiG-19	Fighter/ground attack	(1979)	(1980)	(60)	Unconfirmed
							(1981)	(60)	
			17	MiG-21FL	Fighter	(1980)	1981	17	
			..	MiG-23	Fighter	(1980)	(1980)	(15)	
							1981	(15)	
			1	Sonya Class	MSC	(1981)	1981	1	
			..	T-62	MBT	(1980)	1981	(30)	Unconfirmed
13	Djibouti	Germany, FR	1		PC	(1980)			FR Germany funding; deal incl 11 military vehicles; MAP
		Iraq	8	VCR-6	APC	(1981)	1981	8	Originally from France
14	Dominican Republic	USA	3	A-37B Dragonfly	Fighter/COIN	1981	1982	3	
			2	Model 205 UH-1H	Hel	1981	1982	2	
			12	T-34B Mentor	Trainer	1981			To replace T-41
15	Ecuador	Canada	4	DHC-5D Buffalo	Transport	1981	1981	2	Ordered in addition to 1 delivered 1980
							(1982)	(2)	
		France	(72)	MM-40 Exocet	ShShM	1979	1980	12	6 sextuple launchers ordered Apr 1979 for 6 Wadi Class corvettes
		Israel	12	Kfir-C2	Fighter/bomber	1981			USA approved sale; option for 12 more
		Italy	..	Aspide	AAM/SAM/ShAM	(1979)			Probably for Mirage
			6	Wadi Class	Corvette	1978	1980	1	Similar to Wadi Class for Libya; 3 to be built at CNR, 3 at Ancona
		USA	18	Chaparral	Landmob SAM	1979			
			1	Super King Air	Transport	1980	(1981)	(1)	Total cost incl 3 T-34s; for delivery 1981
8	Egypt	Austria	100	Cuirassier	LT/TD	1981			Also designated SK-105 Jagdpanzer K; may open new arms export market for Austria
		Canada	10	DHC-5D Buffalo	Transport	1981			Ordered Nov 1981
		China	40	F-6	Fighter	1980	(1981)	(20)	In addition to 40 delivered 1979-80

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		(100)	F-7	Fighter	(1982)			Egypt plans to purchase
		. .	SA-2 Guideline	Landmob SAM	1980			Ordered Jan 1980
	France	2	Agosta Class	Submarine	1978			
		30	Alpha Jet	Trainer	1981			Letter of intent signed mid-1980; competing with Hawk; final contract reportedly signed Jan 1981
		20	Mirage-2000	Fighter/strike	1982			Ordered Jan 1982; option on 20 more
		16	Mirage-5SD	Fighter	1981			
		60	OTOMAT-2	ShShM	1978	1980	(30)	Egypt first export customer of coastal defence version
						(1981)	(30)	
	Italy	(15)	CH-47C Chinook	Hel	1980	1981	(7)	Egypt will probably order an additional 24 Boeing/Agusta Chinooks and 36 Gazelles/Model 500s and 40 Pumas/Blackhawks
						(1982)	(8)	
		6		FAC	1980			For Coast Guard
		2	Lupo Class	Frigate	(1980)			
		24	OTOMAT-1	ShShM	1978	1981	8	Arming 6 Ramadan Class FACs under construction in the UK
	Saudi Arabia	1	C-123 Provider	Transport	(1980)	1981	1	Transferred from Saudi Arabia
	UK	6	Ramadan Class	FAC	1978	1981	2	1 delivered Jun 1981; 1 delivered Sep 1981
		14	SRN-6	Hovercraft	(1980)			No official confirmation
	USA	600	AGM-65A	ASM	1980	1980	(75)	Arming F-16s
						(1981)	(100)	
		350	AIM-9P	AAM	1979			Arming 40 F-16s
		(1282)	BGM-71A TOW	ATM	1981	1981	(400)	
		6	C-130H Hercules	Transport	1981	(1982)	(6)	Ordered at Paris Air Show; for delivery late 1982
		4	E-2C Hawkeye	AEW	1981			
		40	F-16A	Fighter/strike	1980	(1981)	(8)	
						(1982)	(32)	
		40	F-16A	Fighter/strike	1981			In addition to 40 on order; principle agreement for a total of 150 F-16s; for delivery over next 5 years
		35	F-4 Phantom	Fighter	(1981)			Version E; gift; in addition to 35 delivered in 1980
		50	M-106-A1	APC	(1979)	1981	(10)	Requested Jul 1979
		400	M-113-A2	APC	1980	1981	(100)	DoD informed Congress; second batch bringing total to 1 100 incl other versions

		400	M-113-A2	APC	1979	1980 1981	(200) 200	Deal arranged Jun 1978 during War Minister Gamassi's visit to USA; several hundred reportedly on order to replace Soviet types
		50	M-125-A1	APC	(1979)	1981	(10)	Requested Jul 1979
		50	M-548	APC	(1979)	1981	(10)	Requested Jul 1979
		50	M-577-A1	CPC	(1979)	1981	(10)	Requested Jul 1979
		43	M-578	ARV	(1980)			Total cost incl 43 M-88-A1s; pending congressional approval
		439	M-60-A3	MBT	1980	1981	(128)	Order incl 40 F-16s; 250-300 more planned for delivery 1985
		43	M-88	ARV	(1980)			Total cost incl 43 M-578; pending congressional approval
		52	M-901 TOW	APC	1980	1981	(26)	Improved version of M-113-A1; armed with TOW ATMs
		36	MIM-23B Hawk	Landmob SAM	1979	1981	36	
		216	MIM-23B Hawk	Landmob SAM	1981			Egypt requests 12 btys; deal incl additional F-16s, M-60 MBTs and 4 Hawkeye AEW aircraft; total order worth $5 bn
		5	S-76 Spirit	Hel	1980			On order
		12	Spectre Class	FAC	(1979)			Incl in $1.5 bn credit package
14 El Salvador	Israel	(4)	Mystere B-2	Bomber	(1981)	1981	(4)	Unconfirmed
	USA	10	Model 205 UH-1H	Hel	1980	1981	(10)	
		4	Model 205 UH-1H	Hel	1981	1981	4	In addition to 10 delivered earlier
		. .	Model 209 AH-1G	Hel	1981			Unspecified number incl in $25 mn MAP package
		3		PC	1976			
13 Equatorial Guinea	Spain	2	C-212A Aviocar	Transport	1980			On order
13 Ethiopia	Canada	2	DHC-5D Buffalo	Transport	(1980)	1981	2	Delivered Jun 1981; uncertain whether sold or leased
	USSR	200	BTR-60P	APC	(1980)	1980 1981	(100) (100)	APCs now being delivered; designation unconfirmed
13 Gabon	Brazil	16	EE-9 Cascavel	AC	1981	1981	16	
		1	EMB-111	Mar patrol	1980	1981	1	For maritime patrol
	France	7	Alpha Jet	Trainer	(1980)			On order
	Italy	4	Sarzana Class	PC	1975	1977	1	First ship, 'Ngolo', delivered 1977
	Spain	2		LST	1981			Ordered Aug 1981; displacement: 650t
	USA	1	L-100-30	Transport	1981	1981	1	Delivered Sep 1981; for Air Force

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
14 Guatemala	Switzerland	12	PC-7	Trainer	1978	1979	(3)	
						1980	(4)	
						1981	5	
15 Guyana	USSR	2	Zhuk Class	PC	(1980)	1981	2	Naval build-up due to conflict with Venezuela; seller and designation unconfirmed
14 Honduras	UK	16	Scorpion FV-101	LT	1978	1981	16	Ordered Mar 1978; delivered Apr 1981
	USA	2		FAC	(1979)	(1980)	(1)	
						1981	1	
9 India	Canada	(8)	DHC-6	Transport	(1981)			For Coast Guard; CASA-212 also being evaluated
	France	150	Mirage-2000	Fighter/strike	(1982)			Finalizing contract; the USSR is offering MiG fighters on favourable terms as alternative
	Germany, FR	2	Type 209	Submarine	(1981)			Finalizing order; for delivery prior to licence production of 6
	UK	(4)	BN-2A Islander	Transport	(1981)			
		40	Jaguar	Fighter	(1979)	(1981)	(10)	Delivery prior to local assembly of 45
		6	Sea Harrier	Fighter/ASW	1979	1982	6	For use with aircraft carrier 'Vikrant'; option for 8 more cancelled
		2	Sea Harrier T-4	Fighter/trainer	1979	1982	2	Ordered Nov 1979; total cost incl 6 Sea Harriers; for delivery late 1982
	USA	2	B-737-200L	Transport	1976	1981	2	Order re-approved by new Gandhi Administration; for delivery 1981; probably version L
		3724	BGM-71A TOW	ATM	1980			Order incl 62 launchers
		230	M-198 155mm	TH	1980			Total cost incl TOW missiles and ammunition; part of $340 mn deal
	USSR	. .	AA-5 Ash	AAM	1980	1981	(40)	Arming MiG-23s; part of USSR arms package to India
		. .	AT-3 Sagger	ATM	1980			
		. .	FROG-7	Landmob SSM	1980			Probably version 7
		. .	Il-76 Candid	Transport	(1981)			Finalizing negotiations; replacing An-12
		(60)	Mi-8 Hip	Hel	1979	1980	40	40 delivered 1980; additional batch arrived early 1981
						1981	(20)	

		(85)	MiG-23	Fighter	1980	1981	(20)	Licence production may follow
		18	MiG-25	Fighter/interc	(1981)	1981	(2)	Counterbalancing sale of F-16 to Pakistan; delivery started
		..	MiG-25R	Recce	(1980)	1981	(8)	8 delivered in first batch; several others reportedly ordered and possibly also delivered
		8	Nanuchka Class	Corvette	1975	1977	1	Total of 8 reportedly to be delivered
						1978	1	
						1979	1	
						1980	1	
		..	Petya Class	Frigate	1980			Missile light frigate; part of USSR arms package to India
		(200)	T-72	MBT	1980	(1980)	(100)	Replacing Vijayanta; an additional 600
						(1981)	(100)	to be licence produced; part of USSR arms package to India incl ATMs, FROGs Petya Class FACs, MiG-23s, Atoll and Ash AAMs, and ASMs
10 Indonesia	Australia	6	N-22L Nomad	Coast patrol	1980	1981	6	Ordered Apr 1980; delivery to start 1981
		6	N-22L Nomad	Coast patrol	1981			For ASW and maritime patrol; in addition to 18 in service; for delivery 1982-83
	Belgium	12		FAC	1980			Ordered from Belgian Shipbuilding Corporation; 12 more to be licence produced
	France	..	AMX-10 PAC-90	MICV/SPG	1981	1981	(5)	Delivered summer 1981
		..	AMX-10P	MICV	1981	1981	(10)	Delivered summer 1981
		3	C-160F Transall	Transport	1979	1982	3	Aerospatiale received order Sep 1979; for delivery early 1982
		..	VPX-110	TD	1980	1981	(10)	Order incl a number of AMX-10s; delivered summer 1981; arms: 90mm gun
	Germany, FR	9		PC	(1980)			For Coast Guard and mar patrol; deliveries to begin in 1981; reportedly on order from France(3) and FR Germany(6)
		2	Type 209	Submarine	1977	1981	2	Modified enlarged version
	Korea, South	4		LST	(1978)	1981	3	3 ships delivered Oct 1981
						1982	1	
		4	PSMM-5 Type	FAC	1976	1981	2	
						(1982)	(2)	
	Netherlands	10	Wasp	Hel	1981	1981	(10)	
	Switzerland	20	AS-202 Bravo	Trainer	1980	1981	20	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	UK	8	Hawk	Adv trainer	1978	1980	6	Last 2 delivered Jan 1981
						1981	2	
		5	Hawk	Adv trainer	1981			Ordered May 1981; in addition to 8 in service; option on 4 more
	USA	16	A-4E Skyhawk	Bomber	1981	1982	16	
		3	B-737-200C	Transport	1981			2 for AEW; 1 for VIP transport; for delivery 1982-83
		2	C-130H Hercules	Transport	1980	1981	2	Ordered when last of 5 C-130H-30 was delivered Jan 1981; 1 intended for maritime patrol
		5	C-130H-30	Transport	1979	1980	4	Last 3 reported as stretched version
						1981	1	
		2	C-130H-30	Transport	1981	(1982)	(2)	Ordered at Paris Air Show; in addition to 5 delivered 1980-81
		3	L-100-30	Transport	1981			Additional order; for delivery Jun 1982
		133	M-101-A1 105mm	TH	(1981)			US Letter of Offer
		6	Model 212 UH-1N	Hel	(1981)			Negotiating
		. .	T-41A	Lightplane	(1980)	(1981)	(5)	Unannounced order
8 Iran	France	12	Kaman Class	FAC	1974	1977	4	Mitterand Government lifted embargo on last 3 Combattante-2 Class FACs
						1978	4	
						1979	1	
						1981	3	
		(66)	MM-38 Exocet	ShShM	(1981)			Arming last 3 Kaman Class FACs
	Italy	75	CH-47C Chinook	Hel	1977	(1978)	(10)	At least 20 delivered; remainder under production; will probably be transferred to Italian AF
						(1979)	(10)	
		100	Seakiller/Marte	AShM	(1978)	(1978)	(50)	Ongoing dispute concerning delay of deliveries; according to Sistel spokesman, some 50 missiles remain to be delivered
	Libya	(60)	T-54	MBT	1981	1981	(60)	
		(65)	T-55	MBT	1981	1981	(65)	
		(65)	T-62	MBT	1981	1981	(65)	MAP; incl T-54/55 MBTs, field guns and small arms
	Netherlands	2	F-27 Mk-400	Transport	1981	1981	2	
	UK	1		Support ship	1974			Ship named 'Kharg'; embargoed after taking of US hostages
8 Iraq	Austria	100	Cuirassier	LT/TD	1981	(1981)	(100)	Reportedly delivered via Jordan

Brazil	..	EE-11 Urutu	APC	(1979)	1979	(50)	
					1980	(50)	
					(1981)	(50)	
	..	EE-17 Sucuri	TD	1979	1979	(50)	
					1980	(100)	
					(1981)	(100)	
	..	EE-9 Cascavel	AC	(1979)	1979	(150)	More than 1 000 EE-9/11/17s delivered by 1981
					1980	(300)	
					1981	(300)	
	..	MAS-1 Carcara	ASM	(1980)	1981		Designation unconfirmed; various missiles reportedly delivered early 1981
Egypt	..	AT-3 Sagger	ATM	1981	1981	(100)	Designation unconfirmed; may be Swingfire; Egypt also supplying ammunition and spare parts
France	(150)	Alpha Jet	Trainer	(1981)			Negotiating; partly built in France and partly locally assembled; agreement not yet signed
	(50)	AMX-10RC	Recce AC	1978	1981	(50)	
	100	AMX-30	MBT	1978	1980	(50)	
					1981	(50)	
	4	Mirage F-1B	Trainer	1977	(1981)	4	
	24	Mirage F-1C	Fighter/interc	1980			Second order, according to French press; reduced from 36 due to wish to buy Mirage-2000
	32	Mirage F-1C	Fighter/interc	1977	1981	32	First batch delivered via Cyprus; all 36 ordered in 1977 will be delivered this year; the remaining 24 will be delivered 1986-87
	..	R-440 Crotale	Landmob SAM	(1979)			Unconfirmed
	..	R-530	AAM	1979			On order
	(160)	Roland-2	Landmob SAM	1981			Ordered Feb 1981; also evaluated were Rapier and Crotale SAM systems
	40	SA-330L Puma	Hel	1979	1981	(40)	Ordered Jul 1979
	(20)	SA-342K Gazelle	Hel	(1978)	(1981)	(20)	In addition to 40 previously delivered
	..	SS-11	ATM	1979			On order
	..	Super Frelon	Hel	(1981)			Finalizing repeat order for unspecified number
	100	VCR-6	APC	(1978)	1979	(25)	Armed with HOT ATMs
					1980	(50)	
					1981	(25)	
German DR	(50)	T-55	MBT	1980	1981	(50)	Surplus; incl some T-54s
Indonesia	..	Bo-105CB	Hel	1980			Undisclosed number ordered; to be armed with French ATWs

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	Italy	. .	Aspide/Albatros	ShAM/ShShM	1979			Arming 4 Lupo Class frigates; designation unconfirmed
		4	Lupo Class	Frigate	1979			Armed with Aspide/Albatros ShAM and Seakiller ShShM
		. .	Sauro Class	Submarine	(1980)			Total cost: $1 200 mn; incl training and assistance in setting up shipyard in Iraq
		. .	Seakiller-2	ShShM	1979			Arming 4 Lupo Class frigates; designation unconfirmed
		6	SH-3D Sea King	Hel	1980			Ordered for VIP use
		1	Stromboli Class	Tanker	1979			Support ship; ordered with 4 Lupo Class frigates and 6 Wadi Class corvettes
		6	Wadi Class	Corvette	1979			
	Poland	300	T-55	MBT	(1980)	1981	(300)	Sale approved by the USSR; replacement for losses in the war with Iran
	Spain	. .	BMR-600	ICV	1981			On order
		. .	C-101 Aviojet	Trainer/strike	(1981)			On order
		20	C-212-200	Transport	1981			Incl in $900 mn 5-year programme
	Switzerland	48	AS-202 Bravo	Trainer	1978	1979	(20)	
						1980	(20)	
		(52)	PC-7	Trainer	1979	1980	(15)	
	USSR	. .		LST	1979			Ordered Jan 1979
		. .	SA-6 Gainful	Landmob SAM	1979	(1980)	(90)	Believed to have received a limited number
						(1981)	(50)	
		. .	SCUD-B	Landmob SSM	(1978)			On order in addition to 12 in service
		3		Submarine	1979			Ordered Jan 1979
		(150)	T-72	MBT	1980	(1981)	(100)	
	Yugoslavia	1		Frigate	1979			
8 Israel	Austria	2	S-65A	Hel	1981	1981	2	
	USA	600	AGM-65A	ASM	1979	1980	(250)	Incl in peace treaty arms package
						1981	(250)	
		600	AIM-9L	AAM	1979	1980	(250)	Ordered Sep 1979; incl in peace treaty arms package; arming F-16s
						1981	(350)	
		. .	BGM-71A TOW	ATM	1981			Arming 18 Model 209 Cobras
		45	Dabur Class	FAC	1973	1977	8	Licence production since 1977
						1978	8	
						1979	8	
						1980	(2)	
						1981	(2)	

		5000	Dragon FGM-77A	ATM	1979	1980	(2500)	Ordered Jul 1980; for delivery
						(1981)	(2500)	1980-81
		40	F-15A Eagle	Fighter/interc	1978	1978	3	Incl in US sales package to Middle East;
						1979	5	approved Feb 1978; total cost incl 75
						1980	5	F-16A fighters
						1981	(20)	
		15	F-15A Eagle	Fighter/interc	1981	1981	2	Compensatory offer due to sale of extra equipment for Saudi Arabian F-15s
		75	F-16A	Fighter/strike	1978	1980	31	
						(1981)	(44)	
		2	Flagstaff-2	Hydrofoil FAC	1977			Prior to possible licence production of 10
		200	M-109-A1 155mm	SPH	1979			
		800	M-113-A2	APC	(1979)	1980	(660)	Included in peace treaty arms package
						(1981)	(140)	
		56	M-548	APC	1979	1981	(20)	
		98	M-577-A1	CPC	1979	(1981)	(50)	
		200	M-60-A3	MBT	(1979)	1980	(50)	
						1981	(50)	
		25	M-88	ARV	1979			
		100	MIM-23B Hawk	Landmob SAM	1979			
		250	Chaparral	Landmob SAM	(1979)			Congress requested to approve purchase; for training and stocks
		18	Model 209 AH-1S	Hel	1981			Armed with TOW ATMs
		30	Model 500MD	Hel	1978	1980	25	Gunship version; armed with TOW
						1981	(5)	
		100	RGM-84A Harpoon	ShShM	(1979)			At least 100 ordered to complement Gabriel; also probably AShM version for F-4 ordered
13 Ivory Coast	France	6	Alpha Jet	Trainer	1977	1980	(4)	
						1981	(2)	
	USA	1	Gulfstream-3	Transport	1981	1981	1	
8 Jordan	France	2	Falcon-50	Transport	(1980)			On order
		36	Mirage F-1C	Fighter/interc	1979			Agreed in principle to purchase instead of F-16, vetoed by USA; Saudi Arabia funding
	UK	5	Bulldog-125	Trainer	1981	1982	5	In addition to 5 ordered in 1980; for delivery 1982
		5	Bulldog-125	Trainer	1980	1981	5	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		278	Khalid	MBT	1979	1981	(50)	In the UK designated FV-4030/2; originally ordered by Iran and designated Shir-1; deliveries started
		50	Tornado IDS	Fighter/MRCA	(1981)			May order
	USA	(72)	AIM-9J	AAM	1979	1981	(72)	Contract confirmed Aug 1979; for 6 F-5Fs
		(192)	BGM-71A TOW	ATM	1981			Arming 24 Model 209 Cobras
		. .	Dragon FGM-77A	ATM	1980			On order; delivery delayed due to tension in Syria
		. .	F-16A	Fighter/strike	1981			Requested Nov 1981; not approved
		6	F-5F Tiger-2	Trainer	1979	1981	6	
		78	M-109-A2 155mm	SPH	1980			In addition to 156 in service
		29	M-110-A2 203mm	SPH	1980			Ordered Jan 1980
		81	M-113-A2	APC	1980	1981	(20)	Ordered Jan 1980
		100	M-60-A3	MBT	1979			Requested Jul 1979; US government approved sale; to replace M-47 and Centurion; 118 conversion kits for older models also being offered by the USA
		30	M-88-A1	ARV	1981			Pending congressional approval
		24	Model 209 AH-1S	Hel	1981			Deal discussed since the mid-1970s and now concluded; total cost incl TOW missiles: $114 mn
		8	Model 500D	Hel	1980	1981	8	
		16	S-76 Spirit	Hel	1980	1980	3	
						1981	10	
						1982	3	
	USSR	. .	SA-6 Gainful	Landmob SAM	1981			Financed partly by Iraq
13 Kenya	France	18	SA-330L Puma	Hel	1977	1978	(6)	
						1979	(4)	
						1981	(8)	
	UK	40	MBT-3	MBT	1979			In addition to 38 previously ordered; probably recce and ARV versions
		. .	Rapier	Landmob SAM	1979			Ordered Mar 1979
		4	Type 56M	PC	1980			On order from Vosper; will also order 4 450t FACs
	USA	(60)	BGM-71A TOW	ATM	1979	1981	(60)	Arming Model 500MD hel
		2	F-5F Tiger-2	Trainer	(1980)	1981	2	In addition to 2 in service

		32	Model 500MD	Hel	(1979)	1980 1981	17 15	15 equipped with TOW ATMs, 15 gunships and 2 trainers
10 Korea, South	USA	(12)	A-10A	Fighter/close support	(1981)			Acc to Krasnaja Svezda; US DoD agreed to sell 1 squadron; unconfirmed; maybe for US forces in South Korea
		200	AGM-65A	ASM	1977			On order
		1800	BGM-71A TOW	ATM	1979	(1980) (1981)	(360) (720)	DoD notified Congress about planned sale Apr 1980; order incl 10 launchers
		30	F-16A	Fighter/strike	1981			Reagan Administration lifted ban on F-16 sales to South Korea; total cost incl 6 F-16B: $900 mn
		6	F-16B	Fighter/strike	1981			
		54	F-5E Tiger-2	Fighter	1975	1978 1979 1980 1981	(15) (15) (15) (9)	
		1	Gearing Class	Destroyer	(1979)			
		37	M-109-A2 155mm	SPH	1978			Ordered Aug 1978
		1089	M-551 Sheridan	LT	(1981)			Part of new US policy to build up South Korean armed forces; unit price: $10 000
		21	M-88-A1	ARV	1981			For delivery 1984
		. .	MIM-23B Hawk	Landmob SAM	(1981)			Undisclosed number to be transferred from US Army
		112	RGM-84A Harpoon	ShShM	1975			Arming 7 PSMM-5 FACs
		. .	Stinger	Port SAM	(1981)			
8 Kuwait	France	(32)	MM-40 Exocet	ShShM	1980			Arming 8 TNC-45 FACs on order from FR Germany
	Germany, FR	8	Type TNC-45	FAC	1980			Ordered May 1980
	Singapore	2		Landing craft	1978			Ordered in addition to 3 in service
	UK	(100)	Chieftain-5	MBT	(1981)			Negotiating
	USA	1350	BGM-71A TOW	ATM	1979			Incl 47 launchers
		4	L-100-30	Transport	1981			Ordered Dec 1981; for delivery 1983
		72	M-113-A2	APC	1980			Pending congressional approval; 20 out of 72 ordered are ambulance version; total cost incl M-901 TOW, M-577-A1 and M-125-A1: $24 mn
		2	M-125-A1	APC	1980			
		14	M-577-A1	CPC	1980			
		6	M-901 TOW	APC	1980			

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
10 Laos	USSR	4	MiG-21F	Fighter	(1981)	1981	4	
8 Lebanon	Austria	. .	Cuirassier	LT/TD	(1981)			Lebanese Army planning rearmament programme with Austrian assistance; designation unconfirmed
		. .	Steyr-4K 7FA	APC	(1981)			Designation unconfirmed
	France	70	AMX-13-105	LT	1978	1981	13	13 delivered Sep 1981
		. .	VAB	APC	(1978)	1981	5	Now being delivered
	Italy	5		PC	1980			Ordered Feb 1980
	UK	. .	Swingfire	ATM	1980			Ordered May 1980
		2	Tracker Class	FAC	1980			On order from Fairey Marine; for customs duties
	USA	69	M-113-A2	APC	(1979)			Required Sep 1979; total cost incl M-125s and M-577s
		27	M-125-A1	APC	1979			
		4	M-577-A1	CPC	(1979)			
13 Liberia	India	6	SA-316B Chetak	Hel	(1981)			Negotiating
12 Libya	Brazil	700	EE-11 Urutu	APC	1981			
	Canada	10	DHC-6	Transport	1979			
	France	10	Combattante-2G	FAC	1975			Delivery withheld due to Libyan intervention in Chad; ban lifted in July 1981; uncertain whether yet delivered
		38	Mirage F-1C	Fighter/interc	1975	1978	(4)	Deliveries withheld due to Libyan intervention in Chad; now to be resumed; incl some A and B versions
		. .	R-530	AAM	(1975)			On order
		40	SA-342K Gazelle	Hel	(1978)			
	Italy	1	AB-212	Hel	(1980)			In addition to 1 delivered in 1980
		28	CH-47C Chinook	Hel	(1979)	(1979)	(8)	
						1980	(12)	
						1981	8	
		20	G-222L	Transport	(1979)	1981	(5)	
		20	G-222L	Transport	(1981)			An additional 20 reportedly ordered due to US refusal to sell C-130s; unconfirmed
		200	Lion	MBT	1978	1980	75	
						(1981)	(75)	

		(168)	OTOMAT-1	ShShM	1977	1978	(12)	Arming 10 Combattante-2G Class FACs and 4 Wadi Class corvettes
						1979	(12)	
						1980	(24)	
						(1981)	(84)	
		(60)	SF-260W Warrior	Trainer/COIN	1981			Bringing total on order to some 300
		..	Type 6616	AC	1979			On order
		4	Wadi Class	Corvette	1974	1978	1	
						1979	1	
						1981	2	
	Netherlands	1	F-27 Mk-600	Transport	(1979)			
	Spain	4	Daphne Class	Submarine	(1981)			May order
	Turkey	1		LST	1980			
		1	SAR-33	PC	1980			
	USA	8	C-130H Hercules	Transport	1973			Delivery embargoed by USA
		2	C-130H Hercules	Transport	(1980)	1981	2	First purchased via dealer in Luxembourg; second leased from bogus company registered in the USA
	USSR	..	AA-2 Atoll	AAM	(1975)	(1976)	(50)	
						(1977)	(50)	
						(1978)	(50)	
						(1979)	(50)	
						(1980)	(50)	
						(1981)	(50)	
		..	AA-6 Acrid	AAM	(1978)	(1979)	(20)	Arming MiG-25s
						(1980)	(20)	
						(1981)	(20)	
		(3)	Foxtrot Class	Submarine	1978	1981	1	On order in addition to 3 in service
		..	MiG-23MB	Fighter/close support	(1978)	(1979)	(15)	
						(1980)	(15)	
						(1981)	(20)	
		..	MiG-25	Fighter/interc	(1977)	(1979)	(15)	
						(1980)	(15)	
						(1981)	(15)	
		2	Natya Class	MSO	(1980)	1981	2	Ships named 'Ishssan' and 'Tayyar'
		12	Scaleboard	Landmob SSM	(1980)	1980	(10)	
						1981	(2)	
		(35)	Su-22 Fitter-C	Fighter/bomber	(1979)	1980	(30)	
						1981	(5)	
13 Madagascar	Brazil	..	EMB-111N	Mar patrol	(1981)			Negotiating
	USSR	..	An-24 Coke	Transport	(1980)	1981	(2)	
		..	BMP-1	MICV	1980	1981	(25)	Designation unconfirmed; deal incl MiG-21s and An-24s

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		. .	MiG-23	Fighter	(1981)	1981	(5)	Small number reportedly delivered
13 Malawi	Germany, FR	6	Do-28D-2	Transport	1979	1980	(3)	Ordered Apr 1979
						1981	(3)	
10 Malaysia	Australia	2	P-3C Orion	ASW/mar patrol	1981	1981	2	Transferred to Commonwealth base in Malaysia; for surveillance; guess version C
	France	. .	MM-40 Exocet	ShShM	1981			Arming 2 FS-1500 Class from FR Germany
	Germany, FR	400	Condor	APC	(1981)			Order incl 103 Marder MICVs
		2	FS-1500 Class	Frigate	1981			Ordered Jun 1981; no further details currently available
		103	Marder	MICV	1981	1981	(50)	Now being delivered together with 400 Condor APCs for police use
	Indonesia	12	Bo-105CB	Hel	(1981)			
	Italy	4	Lerici Class	Minehunter	1980			
	Spain	4	C-212A Aviocar	Transport	(1980)			Acc to some sources, ordered from licence production in Indonesia
	Switzerland	44	PC-7	Trainer	1981			
	UK	6	Type 32M	FAC	1981			Ordered Jan 1981
		90	Scorpion FV-101	LT	(1981)			Negotiating; option for more
	USA	88	A-4E Skyhawk	Bomber	1980			Some sources report Malaysia may purchase A-7s instead
		4	F-5F Tiger-2	Trainer	1979			US letter of offer Apr 1979; incl logistics and support equipment
		2	RF-5E Tiger-2	Recce	1980	1981	2	
13 Mauritania	USA	2	PA-31 Cheyenne	Mar patrol	(1980)	1981	2	For coastal patrol
13 Mauritius	Spain	3	Barcelo Class	PC	1976	1979	2	Delivery delayed due to high speed collision during trials
						1981	(1)	
14 Mexico	Canada	3	DHC-5D Buffalo	Transport	(1980)	1981	3	
	France	40	ERC-90 Lynx	AC	1981			Ordered Jan 1981
		10	SA-315B Lama	Hel	1979			Ordered Nov 1979
	Singapore	1	B-737-100	Transport	1981	1981	1	For VIP transport
	Spain	6	B-119 Type	PC	1980			On order for Coast Guard; unconfirmed
		2	F-30 Class	Frigate	(1981)			Negotiating

	Sweden	12	Spica Class	FAC	(1981)			Negotiating
	Switzerland	55	PC-7	Trainer	1978	1979	(2)	
						1980	(10)	
						1981	(18)	
	UK	36	BN-2A Islander	Transport	1980	1980	(21)	
						(1981)	(15)	
	USA	1	B-727	Transport	(1981)	1981	1	Delivered May 1981
		10	F-5E Tiger-2	Fighter	1980			Total cost incl 2 F-5Fs: $115 mn
		2	F-5F Tiger-2	Trainer	1980			
		1	Gearing Class	Destroyer	(1980)			
12 Morocco	Brazil	. .	EE-11 Urutu	APC	(1981)			Negotiating
		. .	EE-9 Cascavel	AC	(1981)			Negotiating
	France	24	Alpha Jet	Trainer	1978	1979	(4)	
						1980	(8)	
						1981	(12)	
		. .	AML-90	AC	(1978)	1981	(20)	On order
		108	AMX-10RC	Recce AC	(1978)	1980	2	Receiving
						(1981)	(98)	
		6	P-32 Type	PC	1976			On order in addition to 6 in service
		2	PR-72 Type	FAC	1976			On order in addition to 2 in service
		24	SA-342K Gazelle	Hel	1980			Morocco altered decision to buy Model 500MD and chose Gazelle instead
		(400)	VAB	APC	(1979)	1979	(50)	Delivery has started
						1980	(100)	
						1981	(150)	
	Germany, FR	(10)	Do-28D-2	Transport	(1979)			
	Italy	19	AB-206B-2	Hel	1980			Transport version on order
		6	CH-47C Chinook	Hel	(1981)			In addition to 6 in service
	Spain	1	F-30 Class	Frigate	1977			Spanish designation: Descubierta Class
		4	Lazaga Class	FAC	1977	1981	1	
	USA	. .	AGM-65A	ASM	1980			USA approved sale for use with 20 F-5Es; pending congressional approval
		. .	BGM-71A TOW	ATM	1980			For 12 of 24 Model 500MDs; order now uncertain due to Moroccan choice of Gazelles instead of 500MDs
		7	C-130H Hercules	Transport	1981	1981	5	Ordered Jun 1981; first 5 delivered Aug 1981
						(1982)	(2)	
		20	F-5E Tiger-2	Fighter	1980	1980	10	Incl in $245 mn package
						1981	10	
		40	M-163 Vulcan	AAV	(1979)			
		108	M-60-A3	MBT	1981			To modernize 2 battalions
		12	Model 209 AH-1S	Hel	1978			

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		6	OV-10A Bronco	Trainer/COIN	1979	1981	6	
		16	RGM-84A Harpoon	ShShM	(1978)	1981	4	To arm 4 Lazaga Class on order from Spain
13 Mozambique	USSR	(20)	MiG-21MF	Fighter	(1981)			USSR proposed new MiG-21 squadron
14 Nicaragua	Algeria	30	T-55	MBT	(1980)	1981	(30)	Unconfirmed
	France	2	Alouette-3	Hel	1981			Ordered Dec 1981; deal incl 2 patrol boats and a training programme
		2		PC	1981			
	USSR	2	Mi-8 Hip	Hel	(1980)	1981	(2)	Unconfirmed report of deliveries of hels and MBTs
13 Niger	France	. .	AML-90	AC	1981			Unspecified number ordered Mar 1981
	Germany, FR	2	Do-28D-1	Transport	(1979)			On order
13 Nigeria	Austria	(50)	Steyr-4K 7FA	APC	(1980)	1981	(50)	
	Brazil	(100)	EE-9 Cascavel	AC	1981			Designation unconfirmed; well over 100 ordered
	France	12	Alpha Jet	Trainer	1979	1981	(6)	On order
		54	AML-60	AC	1979	1980	(40)	All delivered by Jan 1981
						1981	(14)	
		3	Combattante-3B	FAC	1977	1980	1	
						1981	2	
		18	M3	APC	1979	1980	(9)	Several versions
						1981	(9)	
		36	MM-38 Exocet	ShShM	1977	1980	(12)	Arming Combattante-3 Class FACs
						1981	(12)	
		. .	Roland-2	Landmob SAM	1981			
	Germany, FR	1	Meko-360H	Destroyer	1977	(1981)	1	Sea trials to start Mar 1981
		3	S-143 Type	FAC	1977	1980	1	
						1981	2	
	Italy	6	G-222	Transport	(1981)			Negotiating
		(36)	OTOMAT-1	ShShM	1977	1980	(12)	Arming 3 S-143 Class FACs
						1981	24	
	Netherlands	6		PC	1980			For river patrol
	Switzerland	. .	Piranha	APC	1981			Unspecified number on order
	UK	. .	Blowpipe	Port SAM	1981			

		5	Bulldog-120	Trainer	1980			In addition to 20 in service
		3	Lynx	Hel	1981			Ordered Nov 1981; for delivery 1983-84
		(46)	MBT-3	MBT	1981			Negotiating; order may incl support vehicles
	USA	2	C-130H-30	Transport	(1980)	1981	2	Delivered Nov-Dec 1981
8 Oman	France	(36)	MM-40 Exocet	ShShM	1981			2 triple launchers/ship; arming 2 Province Class FACs on order from the UK
		4	SA-330L Puma	Hel	(1979)			
	Netherlands	2		PC	(1980)	1981	2	Ships named 'Haras 8' and 'Zara 20'
	Singapore	5		PC	1981			On order from Vosper in Singapore
	Sweden	2		PC	1980	1981	1	First delivered Jun 1981; second now under construction
	UK	35	Chieftain-5	MBT	(1981)	1981	(12)	Unofficial reports, order following interim lease of 12 Chieftain-5s from the UK delivered Nov 1981
		12	Jaguar	Fighter	1980			Ordered Jul 1980; in addition to 12 in service
		1	Province Class	FAC	1980			Ordered Mar 1980
		2	Province Class	FAC	1981			Ordered in addition to 1 already on order from Vosper Thornycroft; to be armed with MM-40 Exocet ShShMs
		(45)	Scorpion FV-101	LT	(1981)			Negotiating
	USA	..	AIM-9P	AAM	(1980)			Arming 12 Jaguar on order from the UK
		1	C-130H Hercules	Transport	1980	1981	1	Delivered Mar 1981
		2	C-130H Hercules	Transport	(1981)			Congress notified; including spares for 1 delivered 1981
9 Pakistan	Argentina	..	TAM	MT	(1982)			Negotiating
	China	(65)	F-6bis	Fighter	(1979)	1980	(40)	Also designated A-5 Fantan-A
						1981	(25)	
		..	T-59	MBT	(1975)	(1978)	(50)	China has delivered about 50/year
						(1979)	(50)	
						(1980)	(50)	
						(1981)	(50)	
	France	24	FT-337 Milirole	Trainer	1980			
		18	Mirage-3E	Fighter/bomber	1980			On order
		32	Mirage-5	Fighter	1979	1980	(10)	
						1981	(12)	
		..	R-530	AAM	1980			Undisclosed number on order
		(192)	R-550 Magic	AAM	1978	1980	(60)	Arming 32 Mirage-5s ordered 1979 and now being delivered
						1981	(72)	
	Italy	100	SM-1019E	Lightplane	(1980)			Approved but not signed

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	USA	1005	BGM-71A TOW	ATM	1981			
		2	C-130B Hercules	Transport	(1981)	1981	2	
		(40)	F-16A	Fighter/strike	1981	(1981)	(2)	First 6 to be delivered within a year of signing of contract; partly to be paid for by Saudi Arabia; not incl in $3 200 mn economic and military aid package
		64	M-109-A2 155mm	SPH	1981			
		40	M-110-A2 203mm	SPH	1981			
		. .	M-113-A1	APC	(1978)			On order; 550 in service
		75	M-198 155mm	TH	1981			
		100	M-48-A5	MBT	1981			
		35	M-88-A1	ARV	1981			
		24	M-901 TOW	APC	1981			
		10	Model 209 AH-1S	Hel	1981			Deal incl TOW missiles, MBTs, ARVs, anti-tank vehicles and howitzers
11 Papua New Guinea	Australia	2	N-22L Nomad	Coast patrol	1980	(1981)	(2)	In addition to 3 delivered in 1978; total cost incl spares and technical support
	Singapore	1		Landing craft	(1980)			Launched Jan 1981
15 Paraguay	Brazil	10	EMB-110	Transport	1977			
		9	EMB-326 Xavante	Trainer/COIN	1979	1980	(3)	May order 12 more
						1981	(6)	
		(12)	Uirapuru-122A	Trainer/COIN	1979			In addition to 8 already delivered
	Chile	2	UH-12E	Hel	(1980)	1981	2	
15 Peru	Australia	2	N-22L Nomad	Coast patrol	(1978)			For Army
	France	48	MM-38 Exocet	ShShM	(1980)	1980	24	Arming 4 Friesland Class destroyers
						1981	24	
		6	PR-72P Type	FAC	1976	1979	2	Last ship delivered Sep 1981
						1980	2	
						1981	2	
	Germany, FR	4	Type 209	Submarine	1976	1980	1	In addition to 2 in service
	Italy	96	Aspide/Albatros	ShAM/ShShM	1975	1979	48	Arming Lupo Class frigates
		14	MB-339A	Trainer/strike	1981	1981	(4)	Deliveries to begin late 1981
						(1982)	(10)	
		96	OTOMAT-1	ShShM	1974	1979	48	Arming Lupo Class frigates

		10	Type 6614	APC	1980	1981	10	Arms: 81mm mortar
		15	Type 6616	AC	1981	1981	(15)	
	Netherlands	4	Friesland Class	Destroyer	1980	1980	2	2 delivered Jun 1981; all to be armed with MM-38 Exocet
						1981	2	
	USA	5	C-130H-30	Transport	1980	1981	5	
		2	L-100-20	Transport	1981			
	USSR	100	SA-7 Grail	Port SAM	(1978)			On order
		16	Su-22 Fitter-C	Fighter/bomber	1980	1980	8	
						1981	8	
		200	T-55	MBT	(1978)			On order; in addition to 250 T-54/55s in service
10 Philippines	Netherlands	3	F-27 Maritime	Mar patrol	1980	1981	3	Ordered Apr 1980
	USA	18	Model 205 UH-1H	Hel	1980			Ordered Jun 1980; part of base facility agreement
		18	OV-10A Bronco	Trainer/COIN	1980			President Carter agreed to sell; production-line to be re-opened
8 Qatar	France	6	Alpha Jet	Trainer	1979	1980	3	First sale in Middle East
						1981	3	
		3	Combattante-3	FAC	1980			Ordered Sep 1980; cost incl Exocet missiles
		14	Mirage F-1C	Fighter/interc	1980	1981	(3)	First 3 delivered Mar 1981
		(50)	MM-38 Exocet	ShShM	1980			Arming 3 Combattante-3 Class FACs on order from France
		(50)	MM-40 Exocet	ShShM	1980			3 coastal defence systems ordered
		. .	SA-330 Puma	Hel	1980			Small number recently ordered
		(136)	VAB	APC	(1979)	1980	(10)	
						1981	(50)	
	UK	. .	Rapier	Landmob SAM	(1981)			1 bty ordered; option on more
		8	SH-3D Sea King	Hel	1980			Ordered Oct 1980; for ASW duties; designation also reported as Commando Mk-3
	USA	. .	MIM-23B Hawk	Landmob SAM	1977			Unconfirmed order
14 St Vincent & the Grenadines	UK	1		PC	1980	1981	1	For Coast Guard
8 Saudi Arabia	Austria	(400)	Cuirassier	LT/TD	(1981)			Discussing purchase of up to 400
	France	200	AMX-10P	MICV	1979			Several hundred of unspecified type ordered
		650	AMX-30	MBT	1975	1975	(60)	
						1976	(60)	
						1977	(60)	
						1978	(60)	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
						1979	(60)	
						1980	(60)	
						1981	(60)	
		(100)	AS-15TT	AShM	1980			Arming SA-365N Dauphin hel on 4 guided missile frigates
		(48)	Crotale Naval	ShAM	1980			First export order of naval version; arming F-2000 Class frigates
		4	F-2000 Class	Frigate	1980			Total cost incl Otomat, Dauphin hel, AS-15TT and 2 fuel supply ships; France's most important single arms deal to date
		38	Mirage F-1A	Fighter/ground	(1980)			Possibly ordered for other Arab country; order uncertain
		. .	Mirage-4000	Fighter	(1981)			Developed with Saudi Arabian financial help; may order
		. .	MM-40 Exocet	ShShM	1978			For coastal defence
		(96)	OTOMAT-2	ShShM	1980			Arming 4 F-2000 Class frigates
		8	P-32 Type	PC	1976			Displacement: 90t
		. .	R-440 Crotale	Landmob SAM	1980	(1980)	(50)	In addition to earlier order for Shahine version
						(1981)	(50)	
		(24)	SA-365N	Hel	1980			20 to be armed with AS-15TT; for use on 4 frigates on order from France
		. .	Shahine	Landmob SAM	1974			One section delivered every third month since Jan 1980
		2	Durance Class	Support ship	1980			Fuel supply ship; displacement: 10 000t
	Germany, FR	60	Gepard	AAV	(1981)			With Marder APCs incl in Leopard deal
		240	Leopard-2	MBT	(1981)			Negotiating; necessitates change of FR Germany's arms export policy
		(600)	Marder	MICV	(1981)			Letter of intent signed in 1978
		(100)	Tornado IDS	Fighter/MRCA	1981			Requested Jan 1981
		480	Tpz-1	APC	(1981)			240 Leopard-2 MBTs and 60 Gepard AAVs are also incl in proposed deal
	Spain	40	C-212A Aviocar	Transport	1979			
	UK	. .	FH-70 155mm	TH	(1981)			FR Germany reportedly approved of sale
		(40)	Hawk	Trainer/strike	1981			25-40 ordered
		8	SRN-6	Hovercraft	(1980)	1981	(2)	Mk 8 of the SRN-6 series
	USA	916	AGM-65A	ASM	1979			Proposed sale Dec 1979 to arm F-5 fighters; part of large package deal to Saudi Arabia

(240)	AIM-7F Sparrow	AAM	1978			Arming F-15 fighters
1177	AIM-9L	AAM	1981			Arming F-15 fighters; not incl in initial contract
(660)	AIM-9P	AAM	1981			Incl in F-15 programme; ordered number unconfirmed
9	As Saddiq Class	FAC	1977	1980	3	Ordered Feb 1977
				(1981)	(4)	
				(1982)	(2)	
1	B-747-131	Transport	1977			On order
4	Badr Class	Corvette	1977	1980	1	Ordered Sep 1977
				(1981)	(3)	
1000	BGM-71A TOW	ATM	1980			Incl 50 M-110-A1 guided missile launchers; DoD proposed sale
5	E-3A Sentry	AEW	1981			Congress notified; the 4 USAF AWACS to be kept in Saudi Arabia until deliveries begin in 1985
45	F-15A Eagle	Fighter/interc	1978	(1982)	(32)	Incl in US sales package to Middle East; approved Feb 1978; order incl 15 TF-15A trainers
2	F-15C Eagle	Fighter	1980			DoD offered to sell; to be retained in USA until needed as replacement
6	KC-135	Tanker	(1981)			
1	Learjet-35A	Transport	(1980)	1981	1	
50	M-110-A1 203mm	SPH	(1980)			Offered as launchers for TOW; cost incl 1 000 TOW missiles
18	M-198 155mm	TH	1981			
118	M-60-A1	MBT	1979	1980	32	Replacing 32 sent to North Yemen; order incl 86 tank chassis for air defence; to be armed with 33-mm Oerlikon AAG
(1458)	MIM-23B Hawk	Landmob SAM	1974	(1978)	(400)	Replacing old Hawk systems
				(1979)	(400)	
				(1980)	(400)	
				1981	(258)	
. .	MIM-43A Redeye	Port SAM	1977			On order
(96)	RGM-84A Harpoon	ShShM	1978	1980	(24)	For 4 Badr Class corvettes
				1981	(72)	
(108)	RGM-84A Harpoon	ShShM	1977	1980	(36)	Arming 9 As Saddiq Class FACs
				1981	(48)	
				(1982)	(24)	
15	TF-15A Eagle	Trainer	1978	1981	6	Incl in US sales package to Middle East; approved in Feb 1978
				(1982)	(9)	
579	V-150 Commando	APC	(1980)			For modernization of National Guards

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
13 Senegal	France	(1)	PR-72 Type	FAC	1979	1981	(1)	Ordered Nov 1979; for delivery 1981; arms: 2x76mm Oto Melara cannon
11 Seychelles	USSR	. .	Zhuk Class	PC	(1980)	1981	1	Delivered Oct 1981
10 Singapore	France	150	AMX-13	LT	1978	1980	30	
						(1981)	(30)	
	UK	. .	Rapier	Landmob SAM	1981			In addition to 10 btys previously acquired
	USA	40	A-4P Skyhawk-2	Fighter	(1981)			Probably as attrition aircraft and for spares
		200	AGM-65A	ASM	1981			Total cost incl launchers: $26 mn
		6	F-5E Tiger-2	Fighter	1980			DoD notified Congress; in addition to 21 F-5E/Fs already in service; total cost incl spares and support equipment
		. .	MIM-23B Hawk	Landmob SAM	1979			3 systems ordered Jul 1979
		20	Model 204 UH-1B	Hel	(1980)	1981	(20)	20 or more transferred from US Army
13 Somalia	China	20	F-6	Fighter	(1979)	1980	(6)	
						(1981)	(14)	
	Egypt	. .	T-54	MBT	(1980)	1981	(50)	Delivered Jan 1981
	Italy	4	AB-212	Hel	1980			On order
		4	P-166	Transport	(1979)	1981	4	
		6	SM-1019E	Lightplane	1980			
	USA	(12)	M-163 Vulcan	AAV	1981			Order incl 3 TPS/43 defence radars; in exchange for US base rights in Berbera and Mogadishu
		(1)	Model 150	Trainer	(1981)	1981	(1)	At least 1
13 South Africa	Israel	(108)	Gabriel-2	ShShM	1977			Arming 6 new Reshef Class FACs now being built under licence in Durban
13 Sudan	Egypt	. .	MIM-23B Hawk	Landmob SAM	(1981)	1981	(12)	Unspecified number reportedly delivered
		. .	Swingfire	ATM	1981	1981	(200)	Part of Egypt's reinforcement of Sudan
	France	11	AMX-155 Mk-F3	SPH	1981	1981	11	Ordered Mar 1981
		15	M3	APC	1981			
		10	SA-330L Puma	Hel	1977			Unconfirmed

	Saudi Arabia	55	M-41	LT	1981	1981	55	
		17	M-47 Patton	MBT	1981	1981	17	
	UK	10	BAC-167	Trainer/COIN	(1981)			Negotiating
	USA	2	C-130H Hercules	Transport	1979			Ordered Feb 1979; 6 C-130Es in AF use
		10	F-5E Tiger-2	Fighter	1979	1981	(5)	Part of $100 mn aid package approved
						1982	5	after assassination of President Sadat; all delivered by early 1982
		2	F-5F Tiger-2	Trainer	1979	1981	2	
		12	M-109-A2 155mm	SPH	1981	1981	12	Part of $100 mn MAP package; designation unconfirmed
		80	M-113-A2	APC	1979	1981	36	
		8	M-163 Vulcan	AAV	1980	1981	8	
		50	M-60-A1	MBT	1979	1981	20	Ordered Feb 1979
15 Suriname	USA	6	Model 337	Trainer	(1981)			First military aircraft to Suriname since independence in 1975
8 Syria	Czechoslovakia	. .	L-39 Albatross	Trainer	(1980)	1980	(15)	Unconfirmed number delivered
						1981	(15)	
	France	(216)	HOT	ATM	1978	1980	(108)	Arming Gazelle hels
						1981	(108)	
		16	SA-342K Gazelle	Hel	1979	1980	(8)	
						1981	(8)	
		50	SA-342K Gazelle	Hel	1976	1977	(10)	An additional 16 armed with HOT
						1978	(10)	ATMs ordered in 1979
						1979	(10)	
						1980	(10)	
						1981	(10)	
	Italy	18	AB-212ASW	Hel	(1976)			
		6	CH-47C Chinook	Hel	(1980)			
	USA	4	L-100-20	Transport	1980			
	USSR	. .	AA-2 Atoll	AAM	(1979)	(1979)	(48)	Arming MiG fighters now being delivered
						(1980)	(96)	
						(1981)	(96)	
		(800)	BMP-1	MICV	1981			Designation unconfirmed; deal reportedly incl 4 Nanuchka Class corvettes, 2 Tu-126 AEW aircraft, 800 APCs and 700 122/152mm howitzers; total value: $2 000 mn
		. .	FROG-7	Landmob SSM	1979			Ordered Nov 1979; version 7 unconfirmed
		(200)	M-1973 152mm	SPG	1981			Designation unconfirmed
		(500)	M-1974 122mm	SPH	1981			Designation unconfirmed

	Spain	1	F-30 Class	Frigate	1980			On order
	UK	. .	Blowpipe	Port SAM	1981			On request after US refusal to sell Redeye SAMs
	USA	1	C-130H-30	Transport	1981			
		15	F-5E Tiger-2	Fighter	1979	1981	15	Delivered May 1981
		3	F-5F Tiger-2	Trainer	1979	1981	3	Delivered May 1981
		24	M-108 105mm	SPH	1979	(1981)	(24)	
		(34)	M-109-A2 155mm	SPH	1978	1980	(20)	Large number already delivered together with small arms
						1981	(14)	
		24	M-163 Vulcan	AAV	1980	1980	(12)	Ordered Feb 1980
						1981	(12)	
		14	Model 205 UH-1H	Hel	1977	1981	14	
		6	Model 337	Trainer	1980	1981	6	
		2	Model 412	Hel	1981			
		8	OV-10A Bronco	Trainer/COIN	1981			Congress notified
		6	T-37B	Trainer	(1980)	1981	6	Surplus
		94	V-150 Commando	APC	1978	(1980)	(20)	
						1981	(20)	
12 Tunisia	France	3	Combattante-3	FAC	1981			Armed with Exocet ShShMs
		(36)	MM-40 Exocet	ShShM	1981			Arming 3 Combattante-3 Class FACs
	Germany, FR	(3)	Type 57M	FAC	1980			2 to 3 ships ordered 1980 from Lurssen
	Sweden	. .	RBS-70	Port SAM	1979			Agreement at Paris Air Show
	USA	1320	BGM-71A TOW	ATM	1978			Pending congressional approval; incl practice missiles; total cost: incl M-113-A1 APCs and M-577 vehicles
		1	C-130H Hercules	Transport	1980			Replacing old transport aircraft
		4	F-5F Tiger-2	Trainer	1981			DoD intends to sell; incl in 5-year defence modernization programme
		19	M-109-A2 155mm	SPH	1981			Pending congressional approval
		60	M-113-A1	APC	1978	1980	30	Total cost incl BGM-71A TOW and M-577
						(1981)	(30)	
		26	M-163 Vulcan	AAV	1978			Pending congressional approval; Vulcan-Chaparral air defence system
		6	M-577-A1	CPC	1978	1981	6	
		54	M-60-A3	MBT	1981	1981	(12)	Delivery started Aug 1981
		300	Chaparral	Landmob SAM	1980			USA plans to sell; version MIM-72F Improved Chaparral
8 United Arab Emirates	Brazil	. .	EE-9 Cascavel	AC	1980			Ordered Oct 1980
	France	(24)	MM-40 Exocet	ShShM	1977	1979	8	Arming 6 TNC-45 FACs on order from FR Germany
						1980	8	
						1981	8	

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		. .	MiG-23	Fighter	(1978)	1979	(15)	
						1980	(15)	
						1981	(15)	
		. .	MiG-25	Fighter/interc	(1979)	1979	(12)	Large number received 1979-80 acc
						1980	(12)	to Syrian newspaper 'Al Anba';
						1981	(12)	probably more on order
		. .	MiG-27	Fighter/strike	(1980)	1980	(12)	
						1981	(12)	
		4	Nanuchka Class	Corvette	1981			
		. .	SA-8 Gecko	Landmob SAM	1977			On order; possibly being delivered
		(500)	T-72	MBT	1980	1980	(200)	
						1981	(200)	
		2	Tu-126	AEW	1981			
10 Taiwan	Netherlands	2	Zwaardvis Class	Submarine	1981			Contract signed Sep 1981
	USA	500	AGM-65A	ASM	1979	(1980)	(200)	For second batch of 48 F-5E/Fs to be
						1981	(200)	produced under licence
		(600)	AIM-9L	AAM	(1979)	1980	(100)	Approved 1978; delivery Dec 1980-May
						(1981)	(500)	1981; for second batch of 39 F-5Es
		1013	BGM-71A TOW	ATM	1980			DoD notified Congress; incl 49 launchers
		2	Gearing Class	Destroyer	1980	1981	2	
		25	M-109-A2 155mm	SPH	1980			For delivery Mar 1983
		50	M-110-A2 203mm	SPH	1980	(1981)	(25)	
		280	MIM-23B Hawk	Landmob SAM	1980			Sale approved by Congress Oct 1980
		90	MIM-23B Hawk	Landmob SAM	(1980)			DoD notified Congress; in addition to 4 battalions already purchased; to enter war reserve
		284	Sea Chaparral	ShAM	1980			Pending congressional approval
13 Tanzania	Canada	2	DHC-5D Buffalo	Transport	1980	1981	2	Ordered Mar 1980
	Italy	2	CH-47C Chinook	Hel	1980			On order; for delivery 1982
10 Thailand	Australia	20	N-22B Nomad	Transport	1981			For delivery 1982-84
	Brazil	56	EE-9 Cascavel	AC	1980	(1981)	(56)	Ordered Oct 1980
	Indonesia	2	Bo-105CB	Hel	(1979)			
	Italy	2		FAC	(1980)			2 gunboats ordered in addition to 3 Ratcharit Class FACs delivered 1979; for delivery late 1982; displacement: 450t

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
	Germany, FR	6	Type TNC-45	FAC	1977	1979	2	Armed with Exocet ShShMs
						1980	2	
						1981	2	
	Italy	25	OF-40	MBT	1981	1981	(10)	Now being delivered
						(1982)	(15)	
	Spain	4	C-212-200	Transport	1981			On order
	Switzerland	14	PC-7	Trainer	(1981)	1982	14	For Abu Dhabi
	UK	(30)	Hawk	Trainer/strike	1981			First Middle East sale of the Hawk; 18 for Abu Dhabi, up to 12 for Dubai
		. .	Rapier	Landmob SAM	(1981)			
		36	Scorpion FV-101	LT	1978	(1980)	(18)	Ordered early 1978
						(1981)	(18)	
	USA	1085	BGM-71A TOW	ATM	1981			Total cost incl 54 launchers and 101 practice missiles: $28 mn
		2	C-130H Hercules	Transport	(1980)	1981	2	Unannounced order; delivered to Dubai
		343	MIM-23B Hawk	Landmob SAM	1981			DoD intends to sell; total cost incl 7 launch units, support equipment and training: $800 mn
13 Upper Volta	Brazil	1	EMB-110	Transport	(1980)	1981	1	Reportedly sold; unconfirmed
	UK	1	HS-748M	Transport	1981	1981	1	In addition to 1 in service
15 Uruguay	Argentina	(5)	IA-58A Pucara	Trainer/COIN	1980	1981	(5)	Option on 2 more
		9	T-28	Trainer	1980	1981	9	Gift
	Austria	. .	Cuirassier	LT/TD	1980			Undisclosed number on order
	Belgium	. .	FN-4RM/62F	AC	1980			Ordered Apr 1980
		15	Scorpion FV-101	LT	1980			Sold from Belgian co-production of Alvis light tank
	Chile	4	T-34A Mentor	Trainer	(1980)	1981	4	
	France	3	Combattante-2	FAC	1980			Armed with Exocet ShShMs
		(12)	MM-38 Exocet	ShShM	1980			Arming 3 Combattante-2 Class FACs
		3	Vigilante	PC	1979	1981	3	
	Spain	5	C-212-200	Transport	1980	1981	(3)	First delivered Jul 1981
	USA	1	Learjet-35A	Transport	(1979)	1981	1	
		3	S-2G Tracker	Fighter/ASW	1980	(1981)	3	
		1	Super King Air	Transport	(1980)	1981	1	For maritime patrol
		3	T-34C-1	Trainer	(1980)	1981	3	
15 Venezuela	Argentina	(24)	IA-58A Pucara	Trainer/COIN	(1981)			Order incl transfer of production line; deal not finalized

	Germany, FR	2	Type 209	Submarine	1977			On order in addition to 2 in service
	Israel	2	IAI-201 Arava	Transport	(1980)	1981	2	Unannounced follow-on order; delivered Aug 1981
	Italy	8	A-109 Hirundo	Hel	(1979)			Uncertain whether delivered
		10	AB-212ASW	Hel	1977	1980 1981	(4) (6)	For use on Lupo Class frigates; some equipped to launch Sea Killer ShShMs
		48	Aspide/Albatros	ShAM/ShShM	1977	1979 1980	8 24	Arming 4 Lupo Class frigates
		6	Lupo Class	Frigate	1975	1979 1980 1981	1 1 1	Being delivered; armed with Otomat and Aspide ShShM; carries 1 AB-212 ASW hel; first ship, 'Mariscal Sucre', arrived in Venezuela Jul 1980 after extensive sea trials
		72	OTOMAT-1	ShShM	1975	1979 1980	12 36	Arming 4 Lupo Class frigates
	Poland	. .	An-2 Colt	Lightplane	1980			Undisclosed number on order; first sale in Latin America
	Spain	2	C-212-200	Transport	1980	1981	2	
	Sweden	20	Supporter	Trainer/strike	1979	1980 1981	(10) (10)	20 MFI-15/17s delivered as trainers for Air Force
	UK	24	Hawk	Trainer/strike	(1981)			Unconfirmed
	USA	2	C-130H-30	Transport	1981			
		18	F-16A	Fighter/strike	1981			Total cost incl 6 F-16B trainers: $500 mn; deliveries scheduled to start early 1984; pending congressional approval
		6	F-16B	Fighter/strike	1981			Pending congressional approval
		(6)		Landing craft	(1981)	1981	(6)	At least 6 airlifted to Venezuela May 1981; designation uncertain
		2	Model 310	Lightplane	(1980)	1981	2	For Navy; delivered Jun 1981
		2	Model 412	Hel	(1980)	1981	2	For Air Force
8 Yemen, North	Italy	. .	AB-204B	Hel	(1980)	(1981)	(2)	
		1	AB-212	Hel	(1980)	1981	1	For VIP use
	USSR	(96)	AA-2 Atoll	AAM	(1980)	1981	(96)	Arming 16 Su-22 fighters recently delivered
		. .	Mi-4 Hound	Hel	(1980)	(1981)	(2)	
		. .	SA-2 Guideline	Landmob SAM	(1979)			Five btys on order
		(16)	Su-22 Fitter-C	Fighter/bomber	(1980)	1980 1981	(8) (8)	1 squadron
8 Yemen, South	USSR	40	MiG-21MF	Fighter	(1980)	1980 1981	(20) (20)	
		. .	MiG-23	Fighter	1980			Ordered Jun 1980; unconfirmed

Region code/ Recipient	Supplier	No. ordered	Weapon designation	Weapon description	Year of order	Year of delivery	No. delivered	Comments
		..	SA-7 Grail	Port SAM	(1979)	(1979)	(200)	
						(1980)	(200)	
						(1981)		
		..	SA-9 Gaskin	Landmob SAM	(1979)	(1979)	(50)	
						(1980)	(50)	
						(1981)		
		..	T-62	MBT	1980	1980	(20)	Ordered Jun 1980
						1981	(20)	
13 Zaire	Netherlands	4	F-27 Mk-500	Transport	1981			Ordered Feb 1981
13 Zambia	Italy	7	AB-205	Hel	1980	1981	7	
	USSR	..	BTR-60P	APC	(1980)	1980	(50)	Designation unconfirmed
						(1981)	(50)	
		..	FROG-7	Landmob SSM	(1980)	(1980)	(25)	Designation unconfirmed
						(1981)	(25)	
		16	MiG-21F	Fighter	1980	1981	16	Confirmed by Zambian government; part of arms package from the USSR
		..	T-55	MBT	1980	(1980)	(30)	Ordered Feb 1980
						(1981)	(30)	
13 Zimbabwe	UK	1	Canberra B-2	Bomber	1981	1981	1	Surplus
		1	Canberra T-4	Trainer	1981	1981	1	Surplus
		8	Hawk	Adv trainer	1981			
		4	Hunter FGA-9	Fighter/ground	1981	1981	4	Surplus
		1	Hunter T-7	Fighter/trainer	1981	1981	1	Surplus

Appendix 6C

Register of licensed production of major weapons in industrialized and Third World countries, 1981

This appendix includes licensed production of major weapons for which either the licence was bought, production was started, or production was completed during 1981.

The value of licensed production is included in the arms *trade* statistics. It is important to note that the arms trade statistics in chapter 6 cover, for licensed production, only those major weapons *actually produced* and off the assembly line during 1981.

"Licence production is included in the aggregated trade statistics and is valued in the same way as the arms trade. For example, an F-15 fighter aircraft built under US licence in Japan has the same value as a US-built F-15 purchased by Japan. When a country first produces a weapon under licence (for example, US helicopters produced in Italy), this transaction is first calculated as an Italian import from the USA. When Italy then exports these helicopters, for example to Libya, this is calculated again, as a Libyan import. In such cases the same weapon is thus calculated twice, which has been found to be a better reflection of the actual transfer of military technology than other methods." (See appendix 6D.)

The sources and methods for the data collection, and the conventions, abbreviations and acronyms used, are explained in appendix 6D. The entries are made alphabetically, by licensee, licenser and weapon designation.

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of pro-duction	No. produced	Comments
I. Industrialized countries								
11 Australia	UK	14	Fremantle Class	FAC	1977	1980	1	First to be delivered from the UK; the rest to be produced under licence; also designated PCF-420 Class
						1981	(3)	
4 Belgium	Ireland	. .	BDX	APC	1977	(1978)	(50)	Licence-produced version of Timoney
						1979	(50)	
						1980	(50)	
						1981	(50)	
	USA	664	AIFV	MICV	1980			Total number ordered: 1 189 incl 525 M-113s; unit cost: $100 000
		96	F-16A	Fighter/strike	1977	1979	14	
						1980	9	
						1981	16	
						(1982)	(19)	
		20	F-16B	Fighter/strike	1977	1979	4	
						1980	3	
						1981	3	
						(1982)	(3)	
		525	M-113-A1	APC	(1980)			
4 Canada	Switzerland	177	Cougar	AC	1977	1978	(10)	Canada to licence-produce 443 general-purpose armoured vehicles; order incl 243 Grizzlies and 23 Huskies
						1979	(20)	
						1980	(100)	
						(1981)	(47)	
		243	Grizzly	APC	1977	1978	(60)	
						1979	(61)	
						1980	(61)	
						(1981)	(61)	
		23	Husky	ARV	1977	(1979)	(8)	
						(1980)	(8)	
						(1981)	(7)	

	USA	. .	Seasparrow	ShAM/ShShM	1970	1979	50	
						1980	(50)	
						1981	(50)	
3 China	France	50	SA-365N	Hel	1980			Ordered Jul 1980; second batch to be assembled locally; for offshore oil operations; may be equipped with HOT
5 Czechoslovakia	USSR	(1900)	T-72	MBT	1978	1981	300	Preparing for production; direct purchase for at least 3 regiments; to be produced during next 6 years
4 France	USA	. .	FR-172K Hawk XP	Trainer	(1975)	1977	25	
						1978	25	
						1979	25	
						1980	(20)	
						1981	20	
		. .	FT-337 Milirole	Trainer	1969	1975	12	Designation: FTB-337 Milirole; exported to Africa
						1976	12	
						1977	12	
						1978	12	
						1979	10	
						1980	3	
						1981	(5)	
		. .	Model 172K	Lightplane	1976	1976	1	
						1977	(160)	
						1978	(160)	
						1979	(160)	
						1980	(160)	
						1981	(160)	
		. .	Model 182	Lightplane	1975	1975	(10)	
						1976	(20)	
						1977	(20)	
						1978	35	
						1979	35	
						1980	(40)	
						1981	(40)	
		. .	Model 182RG	Lightplane	1975	1978	(10)	
						1979	(10)	
						1980	30	
						1981	(30)	
4 Germany, FR	USA	6700	AIM-9L	AAM	1977	1981	(950)	For delivery 1981-87; NATO co-production programme

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of production	No. produced	Comments
4 Greece	France	6	Combattante-3	FAC	1975	1980	3	Armed with Penguin ShShM
						(1981)	(3)	
	Netherlands	2	Kortenaer Class	Frigate	1980			In addition to 1 purchased directly from the Netherlands; to be built at Eleusis Shipyards with Dutch assistance
4 Italy	France	. .	Roland-2	Landmob SAM	(1981)			Oto-Melara negotiating with Euromissile for licence production
	Germany, FR	. .	Cobra-2000	ATM	1974	1974	(500)	
						1975	(1000)	
						1976	(1000)	
						1977	(1000)	
						1978	(1000)	
						1979	(1000)	
						1980	(1000)	
						1981	(1000)	
	USA	. .	AB-205A-1	Hel	1969	1977	120	
						1978	120	
						1979	(120)	
						1980	(120)	
						1981	(60)	
		. .	AB-206B-3	Hel	1972	1978	(50)	
						1979	(50)	
						1980	(50)	
						1981	(50)	
		. .	AB-206B-LR	Hel	1978	1979	(50)	
						1980	50	
						1981	(50)	
		. .	AB-212	Hel	1970	1979	(10)	In production since 1971
						1980	(10)	
						1981	(10)	
		. .	AB-212ASW	Hel	1975	1978	30	Current production rate: 4-5/month
						1979	30	
						1980	27	
						1981	(48)	
		(126)	CH-47C Chinook	Hel	1968	1977	12	Licence production began in 1970; for Italy, Iran, Libya and Morocco
						1978	12	
						1979	(12)	
						1980	(12)	
						1981	(12)	

		200	M-109 155mm	SPH	1968	1977	18	
						1978	18	
						1979	18	
						1980	18	
						1981	(18)	
		..	M-113-A1	APC	1963	1977	(150)	
						1978	(150)	
						1979	(150)	
						1980	(150)	
						1981	(150)	
		500	Model 500MD	Hel	1976	1977	(12)	
						1978	(12)	
						1979	(20)	
						1980	(20)	
						1981	(20)	
		20	S-61R	Hel	1972	1976	(2)	
						1977	(3)	
						1978	(3)	
						1979	(4)	
						1980	(4)	
						(1981)	(4)	
		..	SH-3D Sea King	Hel	1965	1977	12	In production since 1969
						1978	(12)	
						1979	(12)	
						1980	(2)	
						1981	(2)	
10 Japan	USA	..	AIM-7E	AAM	1972	1977	(90)	Total number produced for F-4E fighters: 700; to continue in production for use with F-15 Eagle fighters
						1978	(90)	
						1979	(90)	
						1980	(90)	
						1981	(90)	
		1350	AIM-7F	AAM	(1979)	1980	(50)	Arming F-15s
						1981	(100)	
		..	AIM-9L	AAM	1981			Production of body, warhead and engine to start in 1981; guidance and control system in 1982
		88	F-15A Eagle	Fighter/interc	1977	1982	(8)	Japan has a total of 100 F-15s on order; 86 will be locally assembled or locally produced fighter versions; of the 14 bought directly from the USA, 12 are trainer and 2 are fighter versions

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of production	No. produced	Comments
		138	F-4EJ Phantom	Fighter	1969	1974	3	First 2 purchased directly; 8 assembled and 130 built locally
						1975	22	
						1976	22	
						1977	22	
						1978	22	
						1979	22	
						1980	22	
						(1981)	(3)	
		. .	KV-107/2A	Hel	1961	1977	(4)	
						1978	(4)	
						1979	(4)	
						1980	(8)	
						1981	(4)	
		. .	MIM-23B Hawk	Landmob SAM	1978	1978	(100)	
						1979	(100)	
						1980	(100)	
						1981	(100)	
		. .	Model 205 UH-1H	Hel	1972	1973	(5)	
						1974	(9)	
						1975	(9)	
						1976	(9)	
						1977	(9)	
						1978	(9)	
						1979	(9)	
						1980	(9)	
						1981	(5)	
		. .	Model 214ST	Hel	1980			Joint production programme for military and civilian markets; agreement signed by Bell Textron and Mitsui in Oct 1980
		58	OH-6D	Hel	1977	1978	(12)	
						1979	(12)	
						1980	(12)	
						1981	(8)	
		42	P-3C Orion	ASW/mar patrol	1978			Not yet in production
		. .	S-61B	Hel	1965	1977	(20)	
						1978	(30)	
						1979	(33)	
						1980	(10)	
						1981	(10)	

		26	Seasparrow	ShAM	1980			Number ordered refers to systems
		51	SH-3B	Hel	1979	1981	(4)	6 ASW version for delivery in FY 1981/82
						(1982)	(2)	
4 Netherlands	USA	840	AIFV	MICV	1981			In addition to 880 in service; 119 will be M-901 TOW version
		22	F-16A	Fighter	1980			In addition to 102 on order; order incl 18 F-16As and 4 F-16Bs
		102	F-16A	Fighter	1977	1979	(5)	Order incl 80 F-16As and 22 F-16Bs to be produced under licence; VFW also to produce for Norway
						1980	(20)	
						1981	(30)	
		18	F-16A	Fighter	1981			In addition to 124 on order
		86	M-109-A2 155mm	SPH	(1980)	1981	(12)	First 6 delivered Jul 1981; Dutch Army already has 118 old M-109s
5 Poland	USSR	..	An-2 Colt	Lightplane	1960	1977	200	
						1978	200	
						1979	200	
						1980	(200)	
						1981	200	
		..	An-28	Transport	1978			In large-scale production by 1982; planned production rate: 200/year
		..	Mi-2 Hoplite	Hel	(1956)	1979	(200)	In production since 1957; 3000 built by end-1979
						1980	(200)	
						1981	(200)	
		(1900)	T-72	MBT	(1978)	(1980)	(50)	In production
						1981	(300)	
4 Portugal	Netherlands	2	Kortenaer Class	Frigate	1981			On order; 1 to be delivered directly; 2 to be licence-produced
5 Romania	France	..	SA-316B	Hel	1971	1977	25	More than 200 produced by 1981
						1978	25	
						1979	25	
						1980	25	
						1981	25	
		99	SA-330 Puma	Hel	1977	1978	(20)	
						1979	(20)	
						1980	(20)	
						1981	(20)	
	UK	25	BAC-111	Transport	1979	1980	(3)	Total cost: $410 mn plus $205 mn for licensed production of Rolls-Royce Spey engine; 20 aircraft for Romanian AF
						1981	(4)	

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of production	No. produced	Comments
7 Spain	France	4	Agosta Class	Submarine	1974			Spanish designation: S-70 Class
		100	AMX-30	MBT	1980	1980	(44)	Ordered Mar 1980; probably assembled locally; in addition to 380 previously assembled under licence
						1981	(56)	
	USA	3	FFG-7 Class	Frigate	1977			Under construction
7 Switzerland	UK	60	Rapier	Landmob SAM	1980			60 towed Rapier systems with Blindfire radar ordered
	USA	. .	Dragon FGM-77A	ATM	(1981)			Licence production agreement reached Aug 1981; further details of plans still awaited
		38	F-5E Tiger-2	Fighter	1980			Order incl 32 F-5E fighters and 6 F-5F trainers; local assembly; in addition to 72 in service
4 Turkey	Germany, FR	. .	Cobra-2000	ATM	1970			Has 85 systems in use; current status of production programme uncertain
		13	SAR-33 Type	PC	1976	1978	(2)	Prototype delivered from FR Germany 1977 for trials; rest of building in Turkey
						1979	(2)	
						1980	(2)	
						1981	2	
		9	Type 209	Submarine	1974	1980	1	Built under licence in addition to 3 delivered from FR Germany
						(1981)	(1)	
	USA	100	Model 500MD	Hel	(1979)			New plant to start licence production within 1 year of contract; 30% indigenization in 1980, to increase to 80% by 1983; planned production rate: 25-30/year
4 UK	France	36000	MILAN	ATM	1976	1979	(1500)	
						1980	(3500)	
						(1981)	(5000)	
	USA	(8000)	BGM-71A TOW	ATM	(1981)			US government offer to UK Army
		. .	Commando Mk-2	Hel	1966	1978	20	A total of 239 Sea Kings and Commandos ordered by May 1980
						1979	(20)	
						1980	(20)	
						1981	(20)	
		. .	SH-3D Sea King	Hel	1966	1978	20	
						1979	20	

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						1980	(20)	
						1981	(20)	
		17	Sea King HAS-5	Hel	(1979)	1980	2	Version 5 selected instead of version 2
						1981	(5)	
		. .	UGM-84A Harpoon	SuShM	(1980)			Arming Churchill Class submarines from 1982; will be built under licence from McDonnell-Douglas
1 USA	France	595	Roland-2	Landmob SAM	1974			Procurement plan revised due to budget cuts; order incl 27 fire units; possibly for use with Rapid Deployment Force
	Switzerland	. .	AU-23A	Transport	1965	1978	20	
						1979	(20)	
						1980	(20)	
						1981	(20)	
	UK	(320)	Hawk	Adv trainer	1981			BAe and McDonnell-Douglas will co-produce new trainer for US Navy
6 Yugoslavia	France	132	SA-342 Gazelle	Hel	1971	1978	(10)	Estimated production rate: 10/year
						1979	(10)	
						1980	(10)	
						1981	10	

II. Third World countries

15 Argentina	France	. .	VAB	APC	(1981)	1981	2	To be armed with HOT on order from Euromissile; receiving 2 prototypes for evaluation
	Germany, FR	6	Meko-140	Frigate	1979			Order incl 4 Meko-360 destroyers to be built by Blohm & Voss
		220	TAM	MT	(1976)	1981	(100)	
		2	Type 1400	Submarine	1977			
		2	Type 1700	Submarine	1977			2 ordered directly from FR Germany; 2 to be licence-produced in Argentina
		300	VCI	ICV	1976	(1980)	(25)	Similar to Marder MICV
						(1981)	(100)	
	USA	. .	Arrow-3	Trainer	1977	1978	(10)	Local development of licence-produced Piper aircraft; for use as military trainer
						1979	(10)	
						1980	(10)	

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of pro-duction	No. produced	Comments
						1981	(10)	
		120	Model 500M	Hel	1972	1977	(12)	Assembly of knocked-down components
						1978	(12)	
						1979	(12)	
						1980	(12)	
						1981	12	
15 Brazil	France	200	AS-350M Esquilo	Hel	1978	1979	6	Ten-year programme
						1980	(20)	
						1981	(15)	
						1981	20	
		30	SA-315B Gaviao	Hel	1978	1979	(3)	France owns 45% of new company; assembly
						1980	(3)	of 30 over 10 years, most for civilian
						1981	3	market
		(34)	SA-330L	Hel	1980			On order
	Germany, FR	. .	Cobra-2000	ATM	1973	(1975)	(10)	In production for Army
						(1976)	(100)	
						(1977)	(200)	
						(1978)	(200)	
						(1979)	(200)	
						1980	(200)	
						1981	(200)	
	Italy	(150)	AM-X	Fighter/ground	1981			Joint production of new Italian fighter/ ground attack aircraft; production to begin in 1982
		184	EMB-326 Xavante	Trainer/COIN	1970	1971	4	AF designation: AT-26 Xavante; initial
						1972	24	licence production contract for 112;
						1973	24	later increased to a total of 184
						1974	24	
						1975	24	
						1976	12	
						1977	24	
						1978	12	
						1979	(12)	
						1980	(12)	
						1981	(12)	
		3	Sauro Class	Submarine	1980			May be followed by 3 more
	USA	. .	EMB-810C	Lightplane	1974	1975	27	Designation: Piper Seneca-2; licence
						1976	23	production contract incl 6 versions;
						1977	20	mostly for civilian market; 10 delivered

							1978	48	to Brazilian AF in 1978; production slowed down
							(1979)	(48)	
							1980	(24)	
							1981	(24)	
15	Chile	France	2	Batral Type	LST	1979			Announced Jan 1980 in Chile
		Switzerland	..	Piranha	APC	1980	1981	(20)	Chile now produces both 4- and 6-wheeled versions
15	Colombia	USA	..	Cessna	Lightplane	1969	1973	65	By Feb 1980 Colombia had assembled a total of 668 Cessna aircraft of various types
							1974	93	
							1975	(90)	
							1976	(90)	
							1977	(90)	
							1978	(90)	
							1979	(90)	
							1980	(92)	
							1981	(90)	
8	Egypt	UK	(5000)	Swingfire	ATM	1977	1979	(250)	
							1980	(500)	
							1981	(500)	
9	India	France	..	MILAN	ATM	(1981)			Negotiating
			140	SA-315B Lama	Hel	1971	1973	(6)	First 40 assembly only, then licence production of 100 from local raw material
							1974	(10)	
							1975	(10)	
							1976	(10)	
							1977	(10)	
							1978	(10)	
							1979	(10)	
							1980	(10)	
							1981	10	
			..	SA-316B Chetak	Hel	(1962)	1978	(15)	HAL has built 221 since 1965
							1979	(15)	
							1980	(15)	
							1981	(30)	
			..	SS-11	ATM	1970	1971	100	For licence-produced B-1 Jonga AVs
							1972	500	
							1973	(1000)	
							1974	(1000)	
							1975	(1000)	
							1976	(1000)	
							1977	(1000)	

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of pro-duction	No. produced	Comments
						1978	(1000)	
						1979	(1000)	
						1980	(1000)	
						1981	(1000)	
	Germany, FR	2	Type 209	Submarine	1981			Option on 4 more
	UK	. .	Gnat T-2 Ajeet	Trainer	1978			Local development from licence-built Gnat; prototype flight-testing 1980-81
		80	Gnat-2 Ajeet	Fighter	1973	1976	(5)	Local development of licence-built Gnat; total requirement of some 100
						1977	(5)	
						1978	(10)	
						1979	(10)	
						1980	(10)	
						1981	(10)	
		20	HS-748M	Transport	1972	1975	2	Programme to be completed by 1983
						1976	2	
						1977	2	
						1978	2	
						1979	2	
						1980	(3)	
						1981	(2)	
		45	Jaguar	Fighter	1979	(1981)	(1)	Local assembly of components; licence production of a further 60 unlikely due to Mirage-2000 deal with France
	USSR	. .	AA-2 Atoll	AAM	1972	1973	30	Arming MiG-21s
						1974	60	
						1975	120	
						1976	120	
						1977	120	
						1978	90	
						1979	60	
						1980	(60)	
						1981	(90)	
		(95)	An-32 Cline	Transport	1980			Ordered Nov 1980
		(50)	MiG-21bis	Fighter	1976	1980	(10)	In addition to 100 previously assembled from kits
						1981	(15)	
		600	T-72	MBT	1980			
10 Indonesia	Belgium	12		FAC	1980			Together with 12 FACs ordered directly from Belgium

		France	15	SA-330L Puma	Hel	1980	1981	(3)	Will include local assembly of SA-332 Super Puma; agreement signed May 1980
		Spain	88	C-212A Aviocar	Transport	1975	1976	3	New plant set up in 1976
							1977	7	
							1978	7	
							1979	(8)	
							1980	8	
							1981	(10)	
8	Israel	USA	10	Flagstaff-3	Hydrofoil FAC	1977			To be licence-produced after delivery of first 2 from USA
10	Korea, North	USSR	. .	MiG-21MF	Fighter	1974			First delivery was reportedly planned for 1978 but no information available
10	Korea, South	Italy	170	Type 6614	APC	1976	1977	20	Not yet in production in Italy
							1978	(20)	
							1979	(50)	
							1980	(50)	
							1981	30	
		USA	36	F-5E Tiger-2	Fighter	1980			Negotiating; total cost incl 32 F-5Fs; some funded via FMS; co-assembly planned
			32	F-5F Tiger-2	Trainer	1980			
			. .	Model 500D	Hel	(1979)	(1979)	(50)	Some 100 delivered early 1980
							(1980)	(75)	
							1981	(75)	
			. .	Model 500MD	Hel	1976	1978	(10)	
							1979	(10)	
							1980	(10)	
							1981	10	
12	Libya	Italy	(160)	SF-260W Warrior	Trainer/COIN	1977			In addition to 80 purchased directly; new assembly plant constructed with Italian assistance
14	Mexico	UK	15	Azteca Class	PC	1975	1976	1	
							1979	4	
							1980	2	
							(1981)	(3)	
13	Nigeria	Austria	. .	Cuirassier	LT/TD	1979	1981	1	Order incl supply of complete factory from Austria; 1 delivered for evaluation

Region code/ Country	Licenser	No. ordered	Weapon designation	Weapon description	Year of licence	Year of production	No. produced	Comments
9 Pakistan	Sweden	25	Supporter	Trainer/strike	1974	1978	5	Designation: MFI-17; first 45 delivered from Sweden; total number planned may be 100
						1979	(5)	
						1980	(5)	
						(1981)	(5)	
	USA	..	T-41D Mescalero	Trainer	1976			Planned production rate: 50/year
15 Peru	Italy	(70)	MB-339A	Trainer/strike	1981			Agreed in principle; Aermacchi will construct factory for production of at least 70 aircraft in Peru
		2	Lupo Class	Frigate	1974			In addition to first 2 delivered from Italy
10 Philippines	Germany, FR	59	Bo-105C	Hel	1974	1976	9	
						1977	9	
						1978	9	
						1979	9	
						1980	9	
						1981	(9)	
	UK	50	BN-2A Defender	Transport	1979	1980	(25)	
						(1981)	(25)	
13 South Africa	France	..	Cactus	Landmob SAM	1974	1978	(100)	
						1979	(100)	
						1980	(100)	
						1981	(100)	
	Israel	6	Reshef Class	FAC	1977			To be built in Durban; in addition to 6 previously acquired
	Italy	..	Impala-2	Trainer/COIN	1974	1974	4	Also designated MB-326K
						1976	(12)	
						1977	(12)	
						1978	(12)	
						1979	(12)	
						1980	(12)	
						1981	(12)	
10 Taiwan	Israel	(4)	Gabriel-2	ShShM	1977			Arming 2 Tzu Chiang Class FACs under construction in Taiwan
	USA	39	F-5E Tiger-2	Fighter	1979	1980	(5)	Additional batch contracted Jun 1979, incl 9 F-5F trainers
						1981	(20)	
		9	F-5F Tiger-2	Trainer	1979	1981	(2)	

Appendix 6D

Sources and methods for the world arms production and trade data

This appendix describes the sources and methods used in the preparation of the SIPRI registers of world arms production and world arms trade. The registers, which are computerized, also constitute the base material for tables and figures presented in the world arms production and world arms trade chapters.

I. Purpose of the data

Together with the data for world military expenditure, 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 of the major weapons now being acquired in all countries.

The arms production registers cover all the major weapons in production or under development in all countries of the world during a given calendar year. A register covering one of the four major weapon categories is presented in each *SIPRI Yearbook* (for definitions of weapon categories, see section II). The register includes indigenous and licensed production of the given weapon category—in this *Yearbook*, of armoured vehicles.

The arms trade registers cover all major weapons on order or delivered to all countries during a given calendar year. Four registers are included in the Yearbooks: arms imports and licensed production for industrialized and Third World countries, respectively.

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 in section VI). The absence of a country from either the arms production or the 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.

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 aeroplanes, harbour tugs and icebreakers.

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 of the buyer country.

The selection of entries for *aircraft* and *warships* presents no particular problems. If an item is purchased by or on behalf of the armed forces of the recipient country, it is included irrespective of type. The category *armoured vehicles* includes all types of tanks, tank destroyers, armoured cars, armoured personnel carriers, infantry combat vehicles as well as self-propelled and towed 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 as a rule 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 arms transactions are continuously being revised in the 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 (*1980*), 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* are followed by a column of figures indicating the number of items delivered that year.

The exact number of weapons ordered as well as the 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 $30 \times 2 \times 3$, or 180. The estimate of three missiles per launcher is also used for warships. Numbers of surface-to-air missiles are calculated primarily on the basis of the launcher—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 are calculated using an estimate of 20 missiles per launch unit.

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 (see also section V). 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 and can be displayed on request.

Before the data are published, 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 not, however, 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 1981 will not be sufficiently complete until 1982.

The data

The data at present being computer-stored are the following.

(*a*) For the *arms production file:* weapon designation, weapon category, designing and producing country, weapon description, the time span for a weapon development project, technical data on weight, speed and range, manufacturing company, the number of weapons planned for production, production rate, the SIPRI value estimate (either for new, second-hand or refurbished weapons), the source for this estimate (see also section IV), and the year of licence if relevant.

(*b*) For the *arms trade file:* buyer, seller, weapon designation, weapon category, date of order, date of final delivery, status of the weapon (new, second-hand or refurbished), buyer and seller organization (for example, government, army, air force, navy, commercial), number ordered, terms of the deal (cash, credit, gift, military aid, loan, offset, arms for oil, illegal, licensed production), total and unit real sales price if available, and delivery years and numbers.

For each entry the source is noted. In future, when the computer storage is completed for all countries from 1945 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 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. Expressed in monetary terms, this heterogeneous flow reflects both the quantity and the quality of the weapons transferred. Aggregated values and percentages are based only on *actual deliveries* during the year or years covered in the tables and figures in which they are presented.

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.

This means that the SIPRI valuation system is not automatically comparable to official economic statistics such as gross domestic product, public expenditure and export/import figures. However, this valuation system has served 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 consistently and that the more sophisticated weapons are always given a higher value than the less sophisticated ones. 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.

Each weapon obtains three separate values—new, second-hand and refurbished. Missiles, however, are only valued as new. Licensed production is included in the aggregated trade statistics and is valued in the same way as the arms trade. For example, an F-15 fighter aircraft built under US licence in Japan has the same value as a US-built F-15 purchased by Japan. When a country first produces a weapon under licence (for example, US helicopters produced in Italy), this transaction is first calculated as an Italian import from the USA. When Italy then exports these helicopters, for example to Libya, this is calculated again, as a Libyan import. In such cases the same weapon is thus calculated twice, which has been found to be a better reflection of the actual transfer of military technology than other methods.

V. The SIPRI sources

The sources of the data presented in the appendices 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 proceedings; reports and hearings; statistics, White Papers, annual reports and other documents issued by governments and agencies; and statements by governments officials and spokesmen.

The total number of sources regularly perused for data is at present about 200. The following sources represent a selection of the first-priority sources for the arms production and trade data.

Journals and periodicals

Afrique Défense (Paris)
Air et Cosmos (Paris)
Air Force Magazine (Washington)
Antimilitarismus Information (Frankfurt/M)
Armies and Weapons/Ground Defence (Monte Carlo)
Asia Monitor (Hong Kong)
Aviation Week & Space Technology (New York)
Beiträge zur Konfliktforschung (Cologne)
Campaign against Arms Trade (London)
China Aktuell (Hamburg)
Current News (Washington)
Defensa (Madrid)
Defense & Economy World Report and Survey (Washington)
Defense & Foreign Affairs Daily (Washington)
Defense & Foreign Affairs Digest (Washington)
Defense Daily (Washington)
Defense Electronics (Palo Alto)
Défense et Diplomatie (Paris)
Defense & Armament (Lille)
Europa Archiv (Bonn)

Far Eastern Economic Review (Hong Kong)
Flight International (Sutton, Surrey)
FMV-aktuellt (Stockholm)
Interavia (Geneva)
Interavia Airletter (Geneva)
International Defense Review (Geneva)
Internationella Studier (Stockholm)
Jane's Defence Review (London)
Keesings Contemporary Archives (Bristol)
Latin America Weekly Report (London)
Marine-Rundschau (Stuttgart)
Maritime Defence International (London)
Middle East Review (New York)
Milavnews (Stapleford)
Militärtechnik (Berlin, GDR)
Military Technology (Cologne)
NACLA Report on the Americas (New York)
NATO's Fifteen Nations (Brussels)
Naval Forces (Aldershot)
Navy International (Dorking)
New Scientist (London)
Osteuropa (Munich)
Science (Washington)
Soldat und Technik (Frankfurt/M.)
Soviet Aerospace (Washington)
Soviet Military Review (Moscow)
Der Spiegel (Hamburg)
Tecnología militar (Bonn)
Voennij Vestnik (Moscow)
Wehrtechnik (Bonn-Duisdorf)
World Missile Forecast (Ridgefield)
Österreichische Militärische Zeitung (Vienna)

Newspapers

Dagens Nyheter (Stockholm)
Daily Telegraph (London)
Financial Times (London)
Frankfurter Allgemeine Zeitung (Frankfurt/M)
Hsiu Hua News (London)
International Herald Tribune (Paris)
Izvestia (Moscow)
Jerusalem Post (Jerusalem)
Le Monde (Paris)
Neue Zürcher Zeitung (Zurich)
New York Times (New York)
Pravda (Moscow)
Svenska Dagbladet (Stockholm)
The Guardian (London)
The Times (London)
Washington Post (Washington)

Annual reference publications

'Aerospace Forecast and Inventory', annually in *Aviation Week & Space Technology* (McGraw-Hill, New York)
Defense and Foreign Affairs Handbook (Copley & Associates, Washington)
Interavia Data: Air Forces of the World (Interavia S.A., Geneva)
Interavia Data: Aircraft Armament (Interavia S.A., Geneva)
International Air Forces and Military Aircraft Directory (Aviation Advisory Services, Stapleford)
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 Armour and Artillery, C. F. Foss (Macdonald & Co., London)
'Military Aircraft of the World' and 'Missile Forces of the World', annually in *Flight International* (IPC Transport Press, Sutton)
The Military Balance (International Institute for Strategic Studies, London)

VI. Conventions

The following conventions are used in the arms production and trade registers:

Conventions

..	Information not available
( )	Uncertain data or SIPRI estimate

Abbreviations and acronyms

AA	Anti-aircraft
AAG	Anti-aircraft gun
AALC	Amphibious assault landing craft
AAM	Air-to-air missile
AAV	Anti-aircraft vehicle
AC	Armoured car
Acc to	According to
ACMM	Anti-cruise-missile missile
ADV	Air defence version
Adv	Advanced
AEV	Armoured engineering vehicle
AEW	Airborne early-warning system
AF	Air Force
ALCM	Air-launched cruise missile
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
ASSV	Assault vehicle
ASuM	Air-to-submarine missile
ASW	Anti-submarine warfare
ATM	Anti-tank missile
ATW	Anti-tank weapon
BL	Bridge-layer
Bty	Battery
COIN	Counter-insurgency
CPC	Command post carrier
ECM	Electronic countermeasures
FAC	Fast attack craft (missile/torpedo-armed)
FSCV	Fire support combat vehicle
FY	Fiscal Year

GLCM	Ground-launched cruise missile
Hel	Helicopter
ICBM	Intercontinental ballistic missile
ICV	Infantry combat vehicle
IDS	Interdiction/strike version
Incl	Including/includes
IRBM	Intermediate-range ballistic missile
Landmob	Land-mobile (missile)
LAV	Light armoured vehicle
LSH	Heavy-lift ship
LST	Tank landing ship
LT	Light tank
Mar patrol	Maritime patrol aircraft
MBT	Main battle tank
MG	Machine-gun
MICV	Mechanized infantry combat vehicle
Mk	Mark
MPWS	Mobile protected weapon system
MRCA	Multi-role combat aircraft
MSC	Minesweeper, coastal
MSO	Minesweeper, ocean
MT	Medium tank
NBMS	Nuclear ballistic missile submarine
NCMS	Nuclear cruise missile submarine
Nucl	Nuclear
PC	Patrol craft (gun-armed/unarmed)
Port	Portable
Recce	Reconnaissance (aircraft/vehicle)
Repl	Replenishment
RL	Rocket launcher
SAM	Surface-to-air missile
SAR	Search and rescue
SC	Scout car
ShAM	Ship-to-air missile
ShShM	Ship-to-ship missile
ShSuM	Ship-to-submarine missile
SLBM	Submarine-launched ballistic missile
SLCM	Submarine-launched cruise missile
SPG	Self-propelled gun
SPH	Self-propelled howitzer
SShM	Surface-to-ship missile
SSM	Surface-to-surface missile
SuAM	Submarine-to-air missile
Sub	Submarine
SuShM	Submarine-to-ship missile

TD	Tank destroyer
TG	Towed gun
TH	Towed howitzer
Tpz	Transport panzer

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.

7. Strategic nuclear weapons

Square-bracketed numbers, thus [1], *refer to the list of references on page* 275.

I. Introduction

The balance between the two great powers in intercontinental nuclear weapons is becoming increasingly unstable. The number of warheads has multiplied, they have been made much more accurate, and many of them are targeted on the silos of the other side. Each side is claiming that the other side is trying for some kind of first-strike capability, while denying that its own objective is anything but defensive. Thus in August 1980 the then US Secretary of Defense, Harold Brown, said:

> In the future, Soviet military programs could, at least potentially, threaten the survivability of each component of our strategic forces. For our ICBMs, that potential has been realized, or close to it. The Soviets are now deploying thousands of ICBM warheads accurate enough to threaten our fixed Minuteman silos. For our bombers the threats are more remote, and for SLBMs, more hypothetical. But the Soviets are developing, for employment in the mid-1980s, airborne radars and anti-aircraft missiles to shoot down our penetrating B-52s. And they are searching intensively for systems to detect and destroy our ballistic missile submarines at sea. These Soviet efforts cannot be ignored. [1]

On the Soviet Union's side, a recent publication of the Ministry of Defence says:

> The M-X, now in its final stage of development, is designed as a first-strike weapon ... According to the tactical and technical specifications of the US Defense Department, the [Trident II] missile will have practically the same combat capability as the M-X ICBM, that is, it will be a first-strike weapon.... The agreed schedule of the Pentagon plans for building up strategic offensive armaments and deploying anti-missile and space defensive systems is timed to complete the development of a so-called first-strike potential in the 1980s. [2]

Given that both sides have substantial numbers of submarine-launched ballistic missiles (SLBMs), and given that the threat of a first strike against these is, as Harold Brown says, hypothetical, this stress on the present or potential first-strike capability of the other side is at first sight puzzling. The scenario suggested on the United States side goes like this. The Soviet Union launches a strike which eliminates all US land-based missiles. It still has enough strategic nuclear weapons in reserve to inhibit the United States from making any reply—since that reply would then bring total devastation on the United States. So there is no US retaliation, either with submarine-launched missiles or with the cruise missiles of the bomber fleet.

There are a number of implausibilities in this scenario, discussed below. Nonetheless it is used, on the United States side, as justification for their new strategic weapon plans—including the development of missiles such as the MX and Trident II, with much greater accuracy than the missiles they replace; the search for a less vulnerable basing system for the MX missile; and the multiplication of cruise missiles. There is also renewed discussion in US strategic journals of the need to establish a 'launch-on-warning' system. To prevent US land-based missiles being caught in their silos, these missiles should themselves be fired as soon as there was evidence that Soviet missiles could reach their target. They should be fired on the basis of a computer analysis of the evidence from various detection devices, without reference to the President [3].

So now, instead of what might once have seemed to be a stable system of deterrence—a balance of mutually assured destruction (MAD)—we have the fear of a first strike being used as the rationale for the very big increases now in prospect in strategic weapon programmes and procurement. Between them, the two great powers, with the nuclear weapons at their command, have a total destructive power which is probably equivalent to about half a million Hiroshima bombs: but that is not enough. There can be no better example of the way in which developments in weapon technology—in this case the increasing accuracy of intercontinental ballistic missiles (ICBMs)—lead to a reduction rather than to an increase in security.

Reality or myth?

Can one conceive of a Soviet leadership, or a US President, ordering an attempt at a first strike—except as a pre-emptive move, in the belief that the other side was about to do the same? It is not legitimate simply to deduce from the increasing accuracy of ICBMs that governments are seriously considering the possibility of launching a first strike in cold blood. The constraints that inhibit any leadership from considering such an option were set out in a classic statement by Henry Kissinger, then Secretary of State:

> Indeed neither side has even tested the launching of more than a few missiles at a time; neither side has ever fired in a North–South direction as they would have to do in wartime. Yet initiation of an all-out surprise attack would depend on substantial confidence that thousands of re-entry vehicles launched in carefully coordinated attacks ... would knock out all their targets thousands of miles away with a timing and reliability exactly as predicted, before the other side launches any forces to pre-empt or retaliate, and with such effectiveness that retaliation would not produce

unacceptable damage. Any miscalculation or technical failure would mean national catastrophe. Assertions that one side is 'ahead' by the margins now under discussion pale in significance when an attack would depend on decisions based on such massive uncertainties and risks. [4]

There is the uncertainty indicated by the increase of accuracy. The 'circular error probability' (CEP)—the indicator normally used—gives the radius of the circle within which half the missiles will fall; half, it must not be forgotten, will fall outside it. The measure of accuracy has, of course, been calculated on trajectories different from those which would actually be employed in an attack. There is the uncertainty of the missile's reliability—not all test firings by any means have been successful. There is the problem in any attempt to compensate for these uncertainties by firing more than one warhead at each silo—the problem of fratricide. It is highly likely that the first of a series of warheads to explode will impair the function of other first-strike warheads in the vicinity before they, in their turn, can explode. Between the shock wave from the first explosion and the development of its mushroom cloud, there is apparently a 'window' where a second warhead may get through, and the duration of the window can be estimated. But remarkable co-ordination would be needed if such windows were to be hit 1 000 times, and the proof of performance would require atmospheric testing in a manner which cannot now be attempted.[1]

Even if one were to suppose that a first strike successfully eliminated virtually all land-based missiles, the leadership which ordered it could not possibly be confident that there would be no retaliation with the submarine-launched ballistic missiles remaining. It has been estimated that an attempt at a first strike on US land-based missiles would produce a quantity of radioactive dust which (according to the Office of Technology Assessment) would kill within a month between 2 and 20 million Americans [5]. What confidence would the Soviet leadership have that under such circumstances the US President would decline to order any retaliation from the submarine-launched ballistic missiles or the bombers with cruise missiles which were still available to him?

The arguments, of course, also apply to an attempted US first strike against Soviet land-based missiles.

To attempt the launch of a first strike against just one part of another country's strategic weaponry would be an act with a very great risk of total catastrophe to the power which launched it. As a realistic technological and political option it lies in the realm of myth. Yet it is this theme —the fear of a first strike—which is presented as the justification for the major new developments in strategic nuclear weaponry which seem likely

[1] The statistical uncertainties of a first strike are discussed in reference [5].

to come about in the next decade. Unfortunately myths are often powerful in political affairs.

The sections which follow discuss, first, the developments in Soviet strategic nuclear forces, and second, the developments on the US side. The section on Soviet strategic nuclear forces is mainly about installations which already exist. Information about Soviet future trends in this matter is, as usual, scanty. On the US side, on the other hand, there is a great deal of information now about future proposals and plans, and these plans are an important part of the story. The Soviet section therefore is mainly about things which the Soviet Union has already done. The United States section is mainly about things which are planned for the future.

II. Developments in Soviet strategic nuclear weapons

The current stock of Soviet intercontinental strategic nuclear delivery systems consists of 1 398 ICBM launchers, 950 SLBM launchers and 156 long-range bombers. Between them, these delivery systems are loaded with 7 000 nuclear warheads—a number which will probably increase over the next few years. Compared with the United States, a larger proportion of total warheads are deployed on land-based ICBMs and a smaller proportion on submarines. The previous section puts forward arguments for suggesting that land-based ICBMs have not, in any realistic sense, become vulnerable to total elimination in a first strike. Insofar as governments nevertheless may have come to believe that is the case, then the situation may appear to be more serious for the Soviet Union than for the United States. However, the Soviet Union is concentrating on increasing the capability and invulnerability of its submarine-based strategic forces; this may change the situation before the end of the decade.

The sections which follow discuss developments in each of the three categories—land-based missiles, submarine-launched missiles and bombers; and there are some comments on the Soviet system of air defence.

Land-based missiles

In the second half of the 1960s, the Soviet Union's strategic weapon programme concentrated on increasing the number of land-based launchers to some kind of parity with the United States. The main developments of the 1970s have consisted not so much of further increases in the number of launchers but rather of replacement of old missiles by more modern ones—by SS-17s, SS-18s and SS-19s. Over half the total number of land-based launchers are now in these new categories. The total stock consists now of 520 SS-11s, 60 SS-13s, 150 SS-17s, 308 SS-18s and about 360 SS-19s. The great majority of the SS-17s, -18s and -19s are equipped with MIRVs (multiple independently targeted re-entry vehicles).

The SS-17 has been deployed in converted SS-11 silos and is the least accurate of the newer Soviet ICBMs. It is believed that it can deliver four warheads over a range up to 10 000 km and is 'cold-launched'. This technique minimizes launch damage to the silo, which can then be reloaded with a missile after the first one has been fired. It would probably take a few days to make a silo ready for refiring a missile—therefore this facility does not violate the provisions of the SALT II Treaty which preclude a rapid reloading capability for ICBM launchers.

The SS-18 is the largest Soviet ICBM, twice as large as the proposed US MX missile. It is believed to be capable of delivering 8 or 10 MIRVed warheads over a range of up to 10 000 km. (If the range decreases, the number of warheads can of course be increased.) The SS-18 is also cold-launched. Together with the SS-19, it is judged to be the most accurate of the Soviet ICBMs.

The SS-19 is comparable in size to the proposed US MX missile. It is believed that it can deliver 6 warheads to a range of 9 000 km, and uses a hot-launch technique in which the missile's engine is ignited while the missile is in its silo.

The replacement of old missiles by these newer types will probably be complete by the mid-1980s. It is also anticipated that the Soviet Union will develop solid-propellant ICBMs to supplement or replace some of the current liquid-propellant systems. Solid-propellant ICBM development and deployment could give the Soviet Union additional flexibility in handling and in basing their missile forces.

Sea-based strategic weapons

The Soviet Union has since the 1960s developed a series of some 60 modern nuclear ballistic missile submarines. The trend has been to increase the number of missile tubes; the range of the missiles has also been steadily extended. The Hotel-class of the early 1960s was followed by the Yankee-class with 12–16 tubes and with missiles which had a range of 3 000–4 000 km. The most modern class of Soviet ballistic missile submarines which is operational is the Delta-class, also with 12–16 missile tubes, but with missiles which have a range of 8 000–9 000 km. The SS-N-18 missile which is carried by the Delta III submarine is a liquid-propelled, two-stage missile; it was the first Soviet submarine-launched ballistic missile to carry multiple warheads. These missiles can be fired at most targets in the USA from Soviet home waters. The submarines equipped with such long-range missiles therefore do not have to expose themselves to any important extent to US anti-submarine warfare systems.

In 1980, the Soviet Union launched a new and very large strategic nuclear submarine, the Typhoon. This is believed to be about 160 m long, to displace about 25 000 tons submerged, and to carry 20 ballistic missiles. This class of submarine should become operational from the mid-1980s onwards and be equipped with a new, more accurate ballistic missile, the SS-NX-20. This missile will probably have up to 12 warheads, and will also be able to cover most targets in the United States from Soviet home waters (its range is 4 200 nautical miles). It is suggested that the Typhoon may be deployed under the ice of the Arctic Ocean, as further protection against US anti-submarine tactics.

Bombers

The Soviet Union has not done much to modernize its long-range bomber fleet. Its heavy bomber capability continues to rest principally on the small and ageing 'Bison–Bear' force, consisting of some 100 turbo-prop Bears and 56 Bisons. Both these types were first deployed in the mid-1950s. There have from time to time been reports of a new heavy bomber. In the US Department of Defense annual report for the fiscal year 1979, Secretary Harold Brown stated: "We now expect to see the first prototype of a new heavy bomber in the near future." It was then expected to fly during 1979. There was a similar report, in December 1981, of a variable-geometry swept-wing bomber photographed on the apron at the Ramenskoye flight test centre [6]. It is obviously too early to say whether there will or will not be any substantial production of a new Soviet heavy bomber.

The Soviet air defence system

Unlike the United States, the Soviet Union maintains a formidable air defence system. This consists of a large number of air defence interceptor aircraft and a very large array of surface-to-air missiles. Now that the United States is planning to deploy a large number of cruise missiles, the Soviet Union will probably upgrade its defence systems specifically to deal with the cruise missile threat. This will probably involve the development of a more effective Airborne Warning and Control System (AWACS) to detect low-altitude penetrators.

One problem for the Soviet Union here is that it is almost certainly more expensive to deploy an effective defence system against cruise missiles than to deploy the cruise missiles themselves. Some experts argue that the main reason why the United States is proposing to deploy

Table 7.1. Soviet strategic weapon delivery capability (mid-1982)

Vehicle	Number of delivery vehicles deployed	Number of warheads per delivery vehicle	Total delivery capability (number of warheads)	Total yield per delivery vehicle (Mt)	Total delivery capability (Mt)
MIRVed vehicles					
SS-17	150	4	600	2	300
SS-18	308	8	2 464	5	1 540
SS-19	360	6	2 160	3	1 080
SS-N-18[a]	256	3	768	0.6	154
Sub-total	1 074		5 992		3 074
Non-MIRVed vehicles					
'Bison' (bombs)	56	2	112	2	112
'Bear' (bombs)	100	3	300	3	300
SS-11	230	1	230	1	230
SS-11 (MRV)	290	3	870	0.6	174
SS-13	60	1	60	1	60
SS-N-5[a]	18	1	18	1	18
SS-N-6[a]	102	1	102	1	102
SS-N-6[a] (MRV)	272	3	816	0.6	163
SS-NX-17[a]	12	1	12	1	12
SS-N-8[a]	290	1	290	1	290
Sub-total	1 430		2 810		1 461
Total	**2 504**		**8 802**[b]		**4 535**

[a] SLBM.
[b] ICBMs carry 72 per cent of the total number of warheads, SLBMs 23 per cent and bombers 5 per cent.

Table 7.2. US strategic weapon delivery capability (mid-1982)

Vehicle	Number of delivery vehicles deployed	Number of warheads per delivery vehicle	Total delivery capability (number of warheads)	Total yield per delivery vehicle (Mt)	Total delivery capability (Mt)
MIRVed vehicles					
Minuteman III	350	3	1 050	0.51	179
Minuteman III (Mk 12A)	200	3	600	1.05	210
Poseidon C-3[a]	320	10[b]	3 200	0.4	128
Trident C-4[a, d]	200	8	1 600	0.8	160
Sub-total	1 070		6 450		677
Non-MIRVed vehicles					
B-52 (SRAMS+bombs)	150[c]	12[d]	1 800	5.6	840
B-52 (bombs)	197[c]	4[d]	788	4	788
Titan II	52	1	52	9	468
Minuteman II	450	1	450	1.5	675
Sub-total	849		3 090		2 771
Total	**1 919**		**9 540**[e]		**3 448**

[a] SLBM.
[b] Average figure.
[c] Including heavy bombers in storage, etc., there are 573 strategic bombers.
[d] Operational loading. Maximum loading per aircraft may be eleven bombs, each of about one megaton.
[e] SLBMs carry 50 per cent of the total number of warheads, bombers 27 per cent and ICBMs 23 per cent.

so many cruise missiles is to try to force the Soviet Union into spending large sums on defensive measures. These would include AWACS aircraft constantly patrolling the Soviet borders to detect enemy cruise missiles, to alert and control interceptor aircraft and surface-to-air missiles and to destroy any incoming cruise missiles. In addition, ground radars would be used to detect low-flying missiles.

III. Developments in US strategic nuclear weapons

The main subject of interest on the US side is, of course, the current proposals for modernizing and expanding the US nuclear strategic armoury. There is clearly a wide gap between the Soviet and the US perceptions of the balance in strategic nuclear weapons. The Soviet perception is probably that they have at last achieved a rough parity in strategic nuclear weapons, and they signed the SALT II agreement as a document which gave expression to that parity. The US Administration has been persuaded that the Soviet Union is, in some sense, ahead in intercontinental nuclear weapons—particularly in its alleged ability to eliminate US land-based intercontinental missiles in a first strike. So the SALT II Treaty has not been ratified, and the new Administration is committed to attempt a radical revision of that Treaty; in the meantime it proposes very substantial new expenditure on strategic weapons. It is, of course, never certain that long-term plans of this kind will be fulfilled in their entirety: there may be economic, environmental or other constraints.

The US proposals cover the whole field of strategic nuclear weaponry —land-based missiles, strategic bombers, cruise missiles, submarine-launched ballistic missiles and command, control and communications. Each of these is discussed in turn.

Land-based intercontinental missiles

The United States will press ahead with the production of the new MX missile, whose characteristics are set out in table 7.3. At least 100 of these missiles are to be deployed, and they should be available by 1986. The proposal of the previous Administration, to put these missiles in multiple protective shelters, has now been rejected. This mobile base scheme involved shuttling 200 MX missiles between 4 600 horizontal shelters. The Reagan Administration's objection to this multiple shelter plan, apart from costs and public protests, was explained by Richard Perle, Assistant Secretary of Defense for International Security Policy, as follows: "The 4 600-shelter program was not persuasive; the USSR could have overcome it relatively easily without new technology in accuracy. They simply would increase the number of re-entry vehicles to go beyond 4 600 to 5 500 or to 6 600 to overcome it" [7]. Perle is assuming here that the Soviet Union would not be constrained by the provisions of the SALT II Treaty; these provisions would prevent the Soviet Union from increasing the numbers of its MIRVs in this way.

Table 7.3. Characteristics of the MX ICBM, compared with the Minuteman III

	MX	Minuteman III
Length (m)	21.5	18.2
Diameter (m)	2.3	1.8
Stages	3[a]	3
Weight (kg)	87 270	35 409
Propellant	Solid[a]	Solid
Guidance	Inertial	Inertial
Launching mode	Cold	Hot
Throw-weight (kg)	3 570	1 000
Range (km)	11 000	9 000
Number of MIRVs	10[b]	3

[a] The post-boost vehicle, which manoeuvres to guide the individual warheads after the three main stages burn out, is liquid-fuelled.
[b] This is the SALT II limit. However, the MX is designed to carry 11 Advanced Ballistic Re-entry Vehicles (about 500 kt each) or 12 ML 12A warheads (about 335 kt each).

Source: Congressional Research Service, Issue Brief Number IB77080.

The Administration's proposal was to put 35–40 of these MX missiles, as an interim measure, into existing ICBMs silos which would be further hardened. US silos are on average hardened to withstand an over-pressure of 2 000 psi (pounds per square inch). The proposal was to harden some 35–40 of them to 5 000 psi. In the view of the Secretary of Defense, these hardened silos should be able to withstand a Soviet attack from the time the missiles roll off the production line in 1985–86 until about 1987–88. This plan may, however, have been shelved.

The research and development on long-term basing options for this MX missile is to concentrate on three possibilities: continuously airborne patrol aircraft; deep underground basing; and ballistic missile defence. The first of these alternative modes envisages the use of an aircraft which is capable of flying for long periods of time over oceans, each carrying an MX missile for airborne launch. Deep underground silo basing would place the MX missiles in holes up to 1 000 m deep. The third option of developing ballistic missile defence would, of course, require the revision, or indeed the abandonment, of the Anti-Ballistic Missile Treaty. Secretary of Defense Caspar Weinberger has said, of the study of the possibilities of anti-ballistic missile defence: "If we find at the conclusion of the study that there is a far more effective system that would require revision of the treaty, I think it's fair to say we wouldn't hesitate to seek those revisions..." [8]. It does appear that, in more than one respect, the present US Administration is envisaging a future in which the development of strategic nuclear weaponry is not constrained by treaty. The decision among these various options—and the Secretary of Defense indicated that it is likely that more than one basing system would be recommended—should be made in time for the fiscal year 1984 budget.

Bombers

The bomber programme is the largest element in the total strategic programme costs (table 7.4). There are three main elements. The first, most immediate development is to upgrade the B-52Gs and B-52Hs so that they can carry some 3 000 cruise missiles; this deployment will begin this year. (The cruise missiles themselves are discussed in the next sub-section.) Secondly, 100 B-1B bombers will be built. The first bombers should be operational in 1986, and a fleet of some 90 aircraft by 1988 or 1989. The B-1B will be equipped to carry air-launched cruise missiles, probably 30 per aircraft. The B-1 bomber programme had been cancelled

Table 7.4. The US strategic weapon programmes for fiscal years 1982–87

Figures are estimates as of October 1981, and are in billions of US dollars, at FY 1982 prices.

Programme	Programme cost	Per cent of total
Bomber programme	63	*35*
B-52 upgrading, 100 B-1 bombers, cruise missiles, development of Stealth bomber		
Sea-based programmes	42	*23*
Trident submarines, Trident-2 missiles, cruise missiles		
Land-based programmes	34	*19*
MX missiles, hardening of silos, new basing system		
Strategic defence	23	*13*
6 AWACS aircraft, 5 squadrons of F-15s, R&D on anti-ballistic missiles		
Command and control systems	18	*10*
Satellites, communications to strategic weapon systems, hardening		
Total	**180**	**100**

Source: Defense Daily, 5 October 1981.

by President Carter in 1977 after four aircraft had been built. The argument of the previous Administration was that they could rely on the B-52s throughout the 1980s, and that they would develop the Advanced Technology Bomber for the 1990s. The new Administration considered that this represented a willingness to accept risks associated with an ageing and vulnerable B-52 force, and risks associated with the uncertain schedule and unproven capabilities of the Advanced Technology Bomber. Hence the decision to procure a fleet of 100 new bombers for the second half of the 1980s.

The third part of the bomber programme is the continuation of an intensive research and development programme for the Advanced Technology Bomber (the so-called 'Stealth' aircraft). By incorporating a number of technological developments, the bomber is to be given a very small radar cross-section to enable it to penetrate enemy air defence systems with a much reduced risk of detection. The research and development programme—which will be undertaken by a Northrop Corporation team—will also involve the development and fabrication of radar-absorbing materials to reduce radar detectability, aerodynamic and flight control systems with low observable characteristics and stealthy terrain-following and avoidance systems.

Cruise missiles

The new plan also accelerates production of the Boeing air-launched cruise missile (ALCM). The ALCM is a small, long-range, subsonic, nuclear-armed, winged vehicle to be deployed on B-52 strategic bombers and eventually on B-1B bombers. The missile is about 6 m long, weighing less than 1 360 kg, has a range of about 2 500 km and will be armed with a nuclear warhead with a yield of about 200 kt.

The ALCM could be launched by B-52s flying outside Soviet territory against air defence systems, to destroy their radars and ground-to-air missiles. Other B-52s would then be able to penetrate into Soviet territory to attack targets with their ALCMs. These missiles are accurate and can therefore be used against small, hardened military targets. They also have relatively small radar cross-sections and are therefore difficult to detect.

The first ALCM was produced in November 1981. The production rate was expected to be 7 per month by January 1982, rising to 14 per month at the end of the year. Twenty ALCMs would be deployed on each of 151 B-52Gs and B-52Hs. ALCMs will about double the number of nuclear weapons the US strategic bomber force carries.

The new Administration also plans to deploy Tomahawk cruise missiles —some of which will be nuclear-armed—on submarines and surface ships. These missiles are the same as the ground-launched missiles. The US

Navy plans to procure 1 720 Tomahawks between FY 1983 and FY 1987. Some of these will be mounted on launchers attached between the external and the pressure hulls of submarines. Each submarine will carry 12 such missiles. Others will be deployed on surface ships. The targets envisaged are land targets, as well as enemy ships. These cruise missiles may be equipped with either conventional or nuclear warheads; their deployment will therefore complicate the negotiation of any future strategic arms control treaties.

Sea-based strategic weapons

The first of the new Trident ballistic missile submarines, the *Ohio*, was commissioned in November 1981. It is approximately twice as large as a Poseidon-Polaris missile submarine: it will carry 24 Trident missiles, with a range of 7 500 km and eight 100-kt MIRVs. (This compares with 16 missiles on Poseidon submarines, with a range of 4 500 km and ten 40-kt MIRVs.) Eight such submarines are now being built; of these, five should be operational by 1987. The missile with which they are now fitted, the Trident C-4 (or Trident I), is also being retro-fitted into Poseidon submarines. Four of these are already in service with the new missile; another six soon will be.

The new strategic plan calls for the development and deployment of the Lockheed Trident D-5 (or Trident II) missile. This new SLBM is planned to have a range of 11 000 km, and carry up to 14 warheads each with a yield of 150 kt. These missiles will be much more accurate than those they replace. The submarines themselves will have more accurate navigation techniques, and the warheads may be fitted with terminal guidance, in which a radar device or laser will search the area around the target after the warhead has re-entered the atmosphere and guide the warhead very accurately to its target. Missiles like the Trident II will then be as accurate as land-based ICBMs, and are seen by the other side as first-strike weapons, capable of destroying enemy ICBMs in their hardened silos.

Strategic defence and communication and control systems

In strategic defence, the programme calls for a substantial upgrading of the North American air surveillance network, the replacement of five squadrons of F-106s with F-15s, the procurement of six additional AWACS surveillance aircraft and the pursuit of an operational anti-satellite system. There will also be substantial research and development in ballistic missile defence, including technology for space-based missile defence.

The communications and control systems programme has four main areas of expenditure. The first is improvement of the survivability, performance and coverage of radars and satellites which provide warning of a Soviet missile attack. The second is an upgrading of the capability of command centres, including in particular mobile command centres that could survive an initial attack. The third is the improvement of communications between the command centres and the strategic weapon systems themselves—ensuring two-way communications in many instances. The fourth is an R&D programme leading to a communications and control system that would survive the first nuclear attack. This probably refers in particular to hardening against the effects of the short but very powerful pulse of electromagnetic radiation (EMP) given off by a high-altitude nuclear explosion: this can produce a surge of voltage in electronic equipment large enough to damage it permanently.

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8. Weinberger, C., in evidence before the US House Armed Services Committee, 6 October 1981, reported in *Defense Daily*, 7 October 1981.

Appendix 7A

US and Soviet strategic nuclear forces, 1973–82

Figures for 1973–76 are as of 30 June; figures for 1977–82 are as of 30 September.
The sources and notes follow the table.

		First in service	Range (nm)	Payload	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Delivery vehicles														
Strategic bombers														
USA	B-52 C/D/E/F	1956	10 000	27 000 kg	149	116	99	83	83	83	83	83	83	83
	B-52 G/H	1959	10 900	34 000 kg	281	274	270	265	265	265	265	265	265	264
	(FB-111	1970	3 300	17 000 kg	66	66	66	66	66	66	66	65	64	63)
USSR	Mya-4 'Bison'	1955	5 300	9 000 kg	56	56	56	56	56	56	56	56	56	56
	Tu-95 'Bear'	1956	6 800	18 000 kg	100	100	100	100	100	100	100	100	100	100
	(Tu-22M 'Backfire'	1975	4 000	9 000 kg	–	–	–	12	24	36	48	60	72	84)
				Long-range bomber total: USA	**430**	**390**	**369**	**348**	**348**	**348**	**348**	**348**	**348**	**347**
				USSR	**156**	**156**	**156**	**156**	**156**	**156**	**156**	**156**	**156**	**156**
Submarines, ballistic missile-equipped, nuclear-powered (SSBNs)														
USA	With Polaris A-2	1962	n.a.	16 × A-2	8	6	3	–	–	–	–	–	–	–
	With Polaris A-3	1964	n.a.	16 × A-3	13	13	13	13	11	10	10	5	5	–
	With Poseidon C-3 conv.	1970	n.a.	16 × C-3	20	22	25	28	30	31	31	25	20	20
	With Trident C-4 conv.	1979	n.a.	16 × C-4	–	–	–	–	–	–	–	6	11	11
	With Trident C-4	1980	n.a.	24 × C-4	–	–	–	–	–	–	–	–	1	1
USSR	'Hotel II' conv.	1963	n.a.	3 × 'SS-N-5'	7	7	7	7	7	7	7	6	6	6
	'Hotel III' conv.	1967	n.a.	6 × 'SS-N-6'	1	1	1	1	1	1	1	1	1	1
	'Yankee'	1968	n.a.	16 × 'SS-N-6'	33	33	33	33	33	33	33	29	27	23
	'Yankee II'	1974	n.a.	12 × 'SS-NX-17'	–	1	1	1	1	1	1	1	1	1
	'Golf IV' conv.	1972	n.a.	4 × 'SS-N-8'	1	1	1	1	1	1	1	1	1	1
	'Hotel IV' conv.	1972	n.a.	6 × 'SS-N-8'	1	1	1	1	1	1	1	1	1	1
	'Delta I'	1973	n.a.	12 × 'SS-N-8'	1	7	12	18	18	18	18	18	18	18
	'Delta II'	1977	n.a.	16 × 'SS-N-8'	–	–	–	–	4	4	4	4	4	4
	'Delta III'	1978	n.a.	16 × 'SS-N-18'	–	–	–	–	–	2	4	10	12	16
				Submarine total: USA	**41**	**41**	**41**	**41**	**41**	**41**	**41**	**36**	**37**	**32**
				USSR	**44**	**51**	**56**	**62**	**66**	**68**	**70**	**71**	**71**	**71**
				Modern subs: USSR	**34**	**41**	**46**	**52**	**56**	**58**	**60**	**62**	**62**	**62**
SLBM (Submarine-launched ballistic missile) launchers on SSBNs														
USA	Polaris A-2	1962	1 500	1 × 1 Mt	128	96	48	–	–	–	–	–	–	–
	Polaris A-3	1964	2 500	3 × 200 kt (MRV)	208	208	208	208	176	160	160	80	80	–

Poseidon C-3	1970	2 500	10 × 40 kt (MIRV)	320	352	400	448	480	496	496	400	320	320
Trident C-4	1979	4 000	8 × 100 kt (MIRV)	–	–	–	–	–	–	–	96	200	200
USSR 'SS-N-5'	1963	700	1 × 1 Mt	21	21	21	21	21	21	21	18	18	18
'SS-N-6 mod. 1'	1968	1 300	1 × 1 Mt	534									
'SS-N-6 mod. 2' conv.	1973	1 600	1 × 1 Mt	–	534	534	534	534	534	534	470	438	374
'SS-N-6 mod. 3' conv.	1973	1 600	2 × 200 kt (MRV)	–									
'SS-N-8'	1973	4 300	1 × 1 Mt	22	94	154	226	290	290	290	290	290	290
'SS-NX-17'	n.a.	..	1 × 1 Mt (MIRV-cap.)	–	12	12	12	12	12	12	12	12	12
'SS-N-18'	n.a.	4 050	3 × 200 kt (MIRV)	–	–	–	–	–	32	64	160	192	256
			SLBM launcher total: USA	**656**	**656**	**656**	**656**	**656**	**656**	**656**	**576**	**600**	**520**
			USSR	**577**	**661**	**721**	**793**	**857**	**889**	**921**	**950**	**950**	**950**
ICBMs (Intercontinental ballistic missiles)													
USA Titan II	1963	6 300	1 × 10 Mt	54	54	54	54	54	54	53	52	52	52
Minuteman I	1963	6 500	1 × 1 Mt	190	100	–	–	–	–	–	–	–	–
Minuteman II	1966	7 000	1 × 1.5 Mt	500	500	450	450	450	450	450	450	450	450
Minuteman III conv.	1970	7 000	3 × 170 kt (MIRV)	310	400	550	550	550	550	550	550	450	350
Minuteman III impr.	1979	7 000	3 × 350 kt (MIRV)	–	–	–	–	–	–	–	–	100	200
USSR 'SS-7 Saddler'	1962	6 000	1 × 5 Mt	190	190	190	130	30	2	–	–	–	–
'SS-8 Sasin'	1963	6 000	1 × 5 Mt	19	19	19	19	19	–	–	–	–	–
'SS-9 Scarp'	1966	6 500	1 × 10–20 Mt	288	288	288	248	188	128	68	–	–	–
'SS-11 mod. 1'	1966	5 700	1 × 1 Mt										
'SS-11 mod. 2' conv.	1973	..	1 × 1 Mt	990	1 010	1 030	950	860	750	640	580	580	520
'SS-11 mod. 3' conv.	1973	..	3 × 200 kt (MRV)										
'SS-11 mod. 3'	1973	..	3 × 200 kt (MRV)										
'SS-13 Savage'	1969	4 400	1 × 1 Mt	60	60	60	60	60	60	60	60	60	60
'SS-18 mod. 1/mod. 3'	1976	5 500	1 × 10–20 Mt	–	–	–	60	120	180	240	308	308	308
'SS-18 mod. 2' conv.	1977	..	8 × 500 kt (MIRV)	–	–	–							
'SS-19' conv.	1976	5 000	6 × 500 kt (MIRV)	–	–	–	80	120	180	240	300	300	360
'SS-17' conv.	1977	..	4 × 500 kt (MIRV)	–	–	–	–	50	100	150	150	150	150
			ICBM total: USA	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 054**	**1 053**	**1 052**	**1 052**	**1 052**
			USSR	**1 547**	**1 567**	**1 587**	**1 547**	**1 447**	**1 400**	**1 398**	**1 398**	**1 398**	**1 398**
			Total, long-range bombers and missiles: USA	**2 140**	**2 100**	**2 079**	**2 058**	**2 058**	**2 058**	**2 057**	**1 976**	**2 000**	**1 919**
			USSR	**2 280**	**2 384**	**2 464**	**2 496**	**2 460**	**2 445**	**2 475**	**2 504**	**2 504**	**2 504**
Nuclear warheads													
Independently targetable warheads on missiles: USA				5 210	5 678	6 410	6 842	7 130	7 274	7 273	7 000	7 032	..
USSR				2 124	2 228	2 308	3 160	3 894	4 393	4 937	5 920	6 848	..
Total warheads on bombers and missiles, official US estimates: USA				6 784	7 650	8 500	8 400	8 500	9 000	9 200*	9 200*	9 000*	..
USSR				2 200	2 500	2 500	3 300	4 000	4 500	5 000*	6 000*	7 000*	..

* 1 January.

Sources and notes for appendix 7A

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 to 1983 (US Government Printing Office, Washington, D.C., 1975–1982) and the statements on *US Military Posture* by the Chairman of the Joint Chiefs of Staff for the same eight 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 to the 'Hotel IV' and 'Golf IV' SS-N-8 test conversions, are given in the defence statements of the US Secretary of Defense and Joint Chiefs.

Notes:

Dates of deployment

The estimates for the year 1982 are planned or expected deployments.

In the case of the official US estimates of total warheads on bombers and missiles (the last two rows of the table), the estimates for 1979–81 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 number 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 became operational in October 1979. The first Trident submarine, with 24 launch tubes for the Trident I or Trident II missile (the latter now under development), began sea trials in 1981 and is therefore considered operational as of 31 September 1981.

The maximum payload of the Poseidon missile is 14 warheads, rather than the 10 shown in the table. It is estimated that, today, 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.) An article in the *New York Times* and an unofficial US Defense Department report, both from the autumn of 1980, have stated that, as the longer-range Trident missiles are phased in, covering more distant targets, the payload of the remaining 304 Poseidon missiles will revert to the originally designed 14 warheads. This will add a total of 1 216 warheads to the US SLBM force in the early 1980s.

US ICBMs

Three hundred of the 550 Minuteman III missiles are being backfitted with the Mark 12A re-entry vehicle, each of which will carry a 350-kt warhead. Moreover, NS-20 improvements in Minuteman III guidance have brought the expected accuracy (circular error probability) of this missile to about 190 m. This gives the current 170-kt Minuteman III warhead a better than 50:50 chance of destroying a Soviet missile silo hardened to 1 000–1 500 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 190-m accuracy, will be about 57 per cent for one shot and close to 95 per cent for two shots.

MIRVed warheads on Soviet ICBMs

The original Soviet ICBM MIRVing programme is coming to an end, with a total of 818 ICBM silos converted to MIRV-capable launchers. The last of 308 SS-9 silos converted to hold the SS-18 were completed in 1980, and the 60 last SS-11 silos converted to hold the SS-19 are expected to be equipped with the SS-19 missile in 1982.

The exact numbers of MIRVed and unMIRVed versions of the SS-17, -18 and -19 are not known. All launchers for these missiles are counted as MIRV launchers for the purpose of the current understanding between the USA and the USSR to abide by the terms of the unratified SALT II Treaty.

Soviet and US bomber aircraft

The long-standing estimate of 140 Soviet long-range bombers has been revised upwards to 156 to conform with Soviet official data made public at the time of the signing of the SALT II Treaty. In past years, the designation 'Tu-20' has been given for the 'Bear' bomber in *SIPRI Yearbooks*. The SALT II Treaty states that the 'Bear' bomber is designated 'Tu-95' in the Soviet Union. Similarly, the Soviet designation for the medium-range bomber known in the West as 'Backfire' is referred to in the table as 'Tu-22M' (as opposed to 'Tu-26' in previous *SIPRI Yearbooks*) to conform with the designation used in the Soviet Backfire statement given to the USA before the signing of the SALT II Treaty.

US medium-range FB-111 strategic bombers are shown in parentheses, and long-range bombers only are included in the bomber totals, to clarify the number of delivery vehicles counted against SALT II limitations.

'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-95 '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 (about 220) in inactive storage. These aircraft will 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.)

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, loads 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 loads total. The official US estimate of 7 000 independent nuclear warheads on Soviet strategic forces in 1981 can be obtained only if it is assumed that all Soviet MIRV-capable ICBMs are deployed with their maximum load and that some of the most recent 'Delta III' submarines have been deployed with a 7-warhead version of the SS-N-18 rather than the 3-warhead version shown in the table as deployed on 'Delta IIIs'.

8. Laser enrichment of plutonium

Square-bracketed numbers, thus [1], *refer to the list of references on page* 289.

I. Introduction

In March 1981, in testimony before a subcommittee of the United States House of Representatives, it was revealed that since 1975 the US Department of Energy has been conducting research on the use of lasers to separate plutonium isotopes [1a]. The research is being carried out at both the Lawrence Livermore and Los Alamos laboratories, and is closely related to similar research and development efforts being carried out on uranium isotope separation [2].

There are two stated purposes for this programme: (*a*) to enable the use of about 70 tonnes of reactor-grade plutonium, presently stored in spent reactor fuel in the USA, to produce the large number of new nuclear weapons demanded by the Carter–Reagan military build-up [1b]; and (*b*) to produce a less radioactive form of plutonium for weapons in order to reduce the exposure of military and civilian personnel to radioactivity [1c].

It is the purpose of this chapter to outline the motivations for this new process and to analyse its implications for efforts to prevent further nuclear weapon proliferation. Sections II and III examine the reasons why the United States wants more plutonium and why it must be isotopically purified. Section IV describes the laser processes and shows why these methods (and possibly one other) are suitable for separating plutonium isotopes, while other techniques currently used to separate uranium isotopes are not applicable to plutonium. Finally, section V analyses the potential political implications of such a development.

II. Motivations for enriching plutonium

Under the Carter and Reagan Administrations the United States has chosen to modernize and expand dramatically its nuclear arsenal. Plans exist to introduce over the next decade a new generation of submarine-launched ballistic missiles (the Trident I and II), several thousand cruise missiles, a new MX land-based ICBM, and a new generation of so-called 'tactical' nuclear weapons, in particular the enhanced radiation weapon or 'neutron bomb'. It is not possible to estimate with precision how many new nuclear warheads will be needed for this programme, but it certainly runs into several thousand and could be as large as 10 000 or more.

To carry out these plans the United States will require substantial new supplies of plutonium. It has been the practice in the past to recycle the plutonium from obsolete weapons into new ones [1d]. Since the 1960s when President Johnson ordered the shutdown of weapon-grade plutonium production this source has been sufficient for US warhead needs. However, President Carter recognized that production would have to be resumed if his weapon development decisions were to be implemented and ordered this resumption in 1980 [1e].

The plutonium production reactor best suited for weapon material is at Savannah River, South Carolina [1f]. This plant is capable of producing substantial quantities of very high-grade plutonium, but for two major reasons this capacity will probably be insufficient to meet the requirements. One of these reasons is the increasing reliance on plutonium for weapons, and the other is the simultaneous need to produce large quantities of tritium, a substance also required for many nuclear weapons.

As nuclear technology has evolved, it has been possible to increase warhead efficiency substantially (i.e., the ratio of explosive yield to weight of the warhead). Nuclear warheads have become smaller and lighter, a development which has been directly responsible for the ability to place many warheads on a single missile (MIRV), or to produce a cruise missile with a 2 500-kilometre range.

There are two fissionable materials which are well suited for use in nuclear explosives. One is an isotope of uranium (^{235}U) and the other an isotope of plutonium (^{239}Pu).[1] In the past both isotopes have been used in many types of nuclear warhead. However research and testing have shown that much more efficient bombs can be made with plutonium [1g]. So, even though future weapons are expected to require less total fissionable material per unit of yield than current ones, a greater percentage of this material will be plutonium, resulting in an increasing demand for plutonium. This means that even if warheads were only replaced on a one-to-one basis, new plutonium would be required. However, the USA plans to deploy far more new warheads than it plans to retire, and considering that many of the older ones are using uranium the demand for new plutonium will be even greater.

The second reason is the direct competition between plutonium and tritium for available production resources. Tritium is an isotope of hydrogen whose nucleus consists of one proton and two neutrons. It is radioactive and decays with a half-life of 12.33 years.[2] Tritium is essential for the

[1] The numbers associated with each element give the total number of neutrons and protons in the nucleus of the atom. Uranium has 92 protons and plutonium 94, and the balance of each nucleus consists of neutrons. Nuclear species with the same number of protons but different numbers of neutrons are called 'isotopes'.

[2] The half-life is the time required for half of any sample of atoms to undergo decay. The shorter the half-life of an isotope the more radioactive it is.

production of all fusion weapons ('hydrogen bombs'), and in particular the neutron bomb [3]. Just as with plutonium, tritium can be recycled from old weapons to new ones, but its relatively short half-life means that there must be a constant source of replenishment. When this requirement is added to the demands of an expanded arsenal it is clear that substantial amounts of tritium will be needed to produce the next generation of US nuclear weapons. Tritium is produced by irradiating lithium with neutrons in the same reactors used to produce plutonium. This means that tritium production competes directly with plutonium production.

In summary, it seems clear that existing facilities for producing weapon-grade plutonium may be inadequate to meet the demands of the planned nuclear weapon build-up. The shift from uranium to plutonium in modern nuclear weapons, the competition of tritium for the limited capacity of existing production reactors, and the substantial planned increase in numbers of deployed warheads all combine to turn attention to reactor-grade plutonium, most of which is bound up in spent fuel assemblies from civilian nuclear power programmes.

III. The need for plutonium isotope separation

Reactor-grade plutonium is a mixture of a number of isotopes, most of which are undesirable for use in nuclear weapons. The basic nuclear reaction which produces plutonium is the absorption of a neutron in the most common isotope of uranium, ^{238}U. The resulting ^{239}U subsequently decays via neptunium-239 to plutonium-239. This reaction goes on in all commercial nuclear reactors, and is the basic principle on which the plutonium fast breeder reactor is based. ^{239}Pu is the isotope best suited for making nuclear explosives. It can be used to sustain an explosive nuclear fission chain reaction in a predictable and controllable way and its radioactivity level is comparatively low. Its half-life is 24 390 years.

However, the production of plutonium in a nuclear power reactor is a much more complex process than the above description would indicate. In such a reactor the fuel is exposed to high neutron fluxes for long periods of time (of the order of three years) and much of the ^{239}Pu which is formed continues to absorb more neutrons to produce ^{240}Pu, ^{241}Pu, ^{242}Pu and so on (see table 8.1). Meanwhile other reactions lead to the production of small amounts of ^{238}Pu.

The other plutonium isotopes are either much more radioactive or, as in the case of ^{240}Pu, they undergo spontaneous fission; that is, they have a tendency to split and release energy and neutrons even when no initial neutrons are present. This is clearly an undesirable property in a nuclear weapon where it is essential to start the chain reaction with a controlled

Table 8.1. Isotopic composition of reactor-grade plutonium

Isotope	Half-life (yrs)	Radioactivity relative to ^{239}Pu[a]	Percentage composition[b]
238	86.4	282	0.8
239	24 390	1	53.8
240	6 580	3.7	23.0
241	13.2	1 850	11.4
242	379 000	0.064	3.3
243	4.98	4 900	7.7

[a] The level of activity of an isotope is inversely proportional to its half-life. The numbers in this column are therefore the ratios of the half-lives of the isotopes to that of ^{239}Pu.
[b] These percentages are approximations, based on the assumption that standard light water reactor fuel has been irradiated in the reactor for three years.

Source: Reference [4].

initiating neutron source in order to achieve maximum performance. The high spontaneous fission rate of ^{240}Pu thus leads to a phenomenon known as 'pre-initiation', analogous to the phenomenon of 'knocking' in a car engine. Just as pre-ignition in a car engine reduces the efficiency of the engine, so pre-initiation can also degrade the performance of a nuclear weapon. So, even though it is possible to make a nuclear explosive out of isotopically impure plutonium, the yield and reliability of such a weapon will be less predictable in proportion to the amount of spontaneously fissioning isotopes present.

The higher levels of radioactivity contributed by the other isotopes (^{241}Pu, ^{243}Pu) make the storage and handling of weapons containing them dangerous and expensive. Even present-day nuclear weapons, which contain plutonium that is at least 93 per cent pure ^{239}Pu (see table 8.2), are considered to be more radioactive than is desirable. One of the rationalizations offered for the US programme to separate plutonium isotopes is the danger of exposure of military and civilian personnel to radioactivity. For example, it has been pointed out that US sailors on nuclear submarines sleep in the same rooms where nuclear warheads are stored [1c]. Apparently it has been

Table 8.2. Plutonium purity categories

Category	Percentage ^{240}Pu
Super-grade (high purity)	2–3
Weapon-grade	less than 7
Fuel-grade[a]	7 to less than 19
Reactor-grade	19 or greater

[a] Fuel-grade plutonium is the type produced in breeder reactors and intended for recycling back to the breeder fuel cycle.

Source: Reference [1h].

determined that the exposures of these men are sufficient to warrant a serious attempt to reduce the radioactivity emitted by nuclear weapons.

A comparison of tables 8.1 and 8.2 shows the degree of isotopic separation which will be needed to turn reactor-grade plutonium into weapon-grade or super-grade material. Note that the percentage of ^{239}Pu in reactor-grade material is down to only about 54 per cent and that 23 per cent of the plutonium is the highly undesirable, spontaneously fissioning ^{240}Pu. In addition, substantial amounts of highly radioactive ^{241}Pu and ^{243}Pu are present. As the third column of table 8.1 shows, these isotopes are respectively 1 850 and 4 900 times as radioactive per gram of material as ^{239}Pu. The other two isotopes seem less important, ^{238}Pu being present in very small quantities and ^{242}Pu having a low activity. Even if the percentages of ^{241}Pu and ^{243}Pu were much smaller, they would still contribute significantly to increasing the radioactivity of the material. This is presumably the reason why the USA wishes to purify its present weapon-grade (93 per cent ^{239}Pu) plutonium to super-grade (97–98 per cent ^{239}Pu).

If it is assumed that most of the 70 tonnes of reactor-grade plutonium available in the United States is in the form shown in table 8.2, then somewhere between 30 and 40 tonnes of pure ^{239}Pu are potentially extractable. The number of weapons this can ultimately produce is not calculable on the basis of open information, since the amounts of plutonium used in modern weapons are closely held secrets. A very rough estimate, probably a lower limit, can be obtained by assuming that about 5 kg of pure ^{239}Pu is required per weapon. With this assumption it can be seen that enough material is present in the reactor waste stockpile to make between 6 000 and 8 000 weapons, very probably more. A source of this magnitude would allow the major portion of US production reactor capacity to be devoted to tritium production and assure ample supplies of nuclear explosives for the proposed acceleration of warhead deployment.

IV. Laser enrichment of plutonium

In order to make the plutonium in spent reactor fuel useful for nuclear weapons some way must be found to separate the ^{239}Pu from the other isotopes. A similar problem arises in the production of uranium explosives, since the fissionable isotope, ^{235}U, must be separated from the non-fissionable one, ^{238}U. This process, called enrichment, was first used during World War II and produced the highly enriched uranium which destroyed Hiroshima.

Since that time a number of methods have been developed for enriching uranium in ^{235}U [5]. These include gaseous diffusion, gas centrifuges, jet nozzles, the vortex tube and a number of chemical exchange processes. The details of these processes are discussed elsewhere [5], and space does not permit a thorough discussion here. For a variety of reasons none of these processes is suitable for the separation of plutonium isotopes. The reasons involve the intense radioactivity of reactor-grade plutonium, the closeness in mass of ^{238}Pu, ^{239}Pu and ^{240}Pu relative to the analagous separation between ^{235}U and ^{238}U, the presence in plutonium of more than just two isotopes, the very large quantities of feed material per unit of output required for some of the above processes, and the problem of preventing the formation of accidental critical masses.

In the past, plutonium isotopes have been separated, but only in relatively small quantities of the order of kilograms [6]. This has been done in a device called the 'calutron', which was also developed in World War II and was used to manufacture the enriched uranium for the Hiroshima bomb [5]. However, this method proved far too expensive and slow to be suitable for producing tens of tonnes of enriched isotopes. Only the urgency of the US wartime bomb programme could even begin to rationalize the enormous amounts of money, materials and technical expertise that went into the original calutrons.

So, until recently, however desirable it may have been to purify large quantities of plutonium isotopically, no practical means existed to do so. The high purity of weapon-grade plutonium was achieved instead by irradiating natural uranium with neutrons for very short periods of time and removing it before large quantities of other isotopes had time to accumulate. This is a relatively inefficient process, but given its military applications, the costs were assumed to be justified.

Now a new set of technologies based on lasers or plasmas[3] threatens to remove the earlier limitations on plutonium isotope separation. These new methods utilize so-called 'resonance' phenomena to excite selectively and then separate the desired isotope from a mixture of isotopes quickly and with relatively high efficiency. The older methods mentioned above rely on gross mass differences between isotopes and can only separate light from heavy constituents, but the resonance methods are highly selective, and can be tuned to pick any desired isotope out of a group in which both heavier and lighter components exist. Whereas most of the older methods require enormous quantities of feed material on which to work, resonance methods use an amount of feed comparable to the amount of product. The older methods also require many separation stages and large numbers of pumps, compressors, centrifuges, and so on, while the resonance methods may be able to accomplish large separations with only a single stage and consume far less energy than many of the older methods.

[3] A plasma is a gas composed of electrons and ions (atoms stripped of one or more electrons; see below).

Detailed descriptions and analyses of the laser and plasma techniques are given elsewhere [2, 5]. None of them has yet reached the pilot plant stage, even for uranium separation, and much of the detailed technical information on the processes is classified. So any analysis of the possible feasibility of plutonium separation must be speculative. It can be said, however, that aside from the problem of increased radioactivity and the somewhat greater risk of accidental criticality, the resonance technologies being designed to separate uranium isotopes should be relatively easily adapted to plutonium isotope separation.

Work has been going on in the USA since 1975 to develop a laser enrichment technique for plutonium [1a]. The method mentioned most prominently for this purpose is the atomic vapour laser isotope separation (AVLIS) technique. In this process pulsed dye lasers, emitting light in the visible portion of the spectrum, are used to excite selectively and ionize ^{239}Pu atoms in a highly rarified atomic vapour produced by heating an ingot of solid plutonium. The ionized ^{239}Pu atoms are then collected by means of pulsed electromagnetic fields, while the unwanted isotopes are allowed to collect in another part of the apparatus.

Optimistic projections have been made for the potential success of this method. Recent testimony states that a pilot plant based on the AVLIS method could be put into operation by 1986 at an estimated cost of $40 million. A full-scale production plant is estimated to cost about $200 million and could possibly be operational by 1987 [1i]. One must apply the usual discount to such projections made by the promoters of a method, but at the same time it does not seem unreasonable to assume that sooner or later some kind of plutonium AVLIS facility will be possible. However, it could turn out to be considerably more expensive than the above figures suggest.

The sizes and production rates of these two projected facilities were edited from the published transcript of the testimony, so it is difficult to estimate the production rates which might be achieved. A rough estimate based on the properties of a uranium AVLIS module [2, 5] leads to a production rate of the order of several hundred kilograms to one tonne per year, using reasonably powerful lasers with high repetition rates. Such a system could be operated without serious criticality dangers by changing the feed ingot and collecting-plates every few hours. Even if the AVLIS technology proves workable, and even if the optimistic schedule mentioned above can be met, it will still be highly unlikely that the enriched plutonium from such a facility could make a major contribution to the proposed weapon build-up in this decade.

Research is also under way at the Los Alamos Laboratory on a method which uses infra-red lasers on plutonium hexafluoride (PuF_6) [1j]. This material has properties remarkably similar to those of UF_6 [4]. The molecular laser isotope separation (MLIS) technique is in many respects simpler and more flexible than the AVLIS process, but even fewer data are publicly available with which to assess its feasibility. The development of infra-red and/or ultraviolet lasers sufficiently powerful and precise to separate large quantities of uranium is apparently still problematical, but should such lasers be developed, there would seem to be no serious obstacles to applying them to plutonium as well.

No public reference exists to indicate that the plasma separation process (PSP) is being explored for possible application to plutonium. In this process ionized plutonium atoms would be induced to spiral down a highly uniform magnetic field inside a long solenoid [5]. A precisely tuned electromagnetic field oscillation would then cause the spiral orbits of the ^{239}Pu ions to increase in radius, causing these ions to be captured by collection plates at the end of the solenoid. The process is being studied intensively for possible application to large-scale uranium enrichment, and many features of the process suggest that it might be used to separate plutonium isotopes if certain technical criteria could be met. The major problem would seem to be the presence of plutonium isotopes which differ in mass by only one unit from the desired isotope, as opposed to the three-unit separation in uranium. This closer separation places much more stringent conditions on the spatial uniformity of the magnetic field in which the plasma is created and on the frequency range over which resonance can be achieved. It is possible that these criteria could be met in relatively small units capable of separating tens or hundreds of kilograms of plutonium per year. Such a production rate would be very helpful in generating the high-quality plutonium needed for new nuclear weapons.

V. Proliferation implications

The most obvious implication of one or more of these techniques would be their contribution to vertical proliferation. They are, after all, explicitly designed to increase the size of current nuclear arsenals considerably.

The implications of these techniques for horizontal proliferation are less direct. All three of the enrichment methods discussed above are still in the research and development stage and seem unlikely to be simple or cheap enough for most non-nuclear weapon countries to develop on their own [2]. The possibility of technological breakthrough always exists, but the best judgement one can make on the basis of available evidence is that laser or plasma separation techniques are most likely to be technologically sophisticated and very expensive. They are not likely to involve components readily available on world markets, and any country wanting to develop such techniques will be faced with high costs and long lead times. And even *if* the technology should eventually become available, it would still be much simpler to use it for producing a uranium-235 weapon. The difference between uranium and plutonium weapons is likely to be immaterial for a proliferator not in possession of the sophisticated weapons of the major powers.

A more likely result of the development and implementation of plutonium enrichment is the further undermining of the already fragile legitimacy of the Non-Proliferation Treaty and its attendant system of safeguards, since the most basic principle of Atoms for Peace—that civilian nuclear materials and facilities must never be used for military purposes—would be violated.

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9. Military use of outer space

Square-bracketed numbers, thus [1], *refer to the list of references on page* 314.

I. Introduction

The unique advantages of artificial Earth satellites circling the globe have now been exploited to a considerable degree, particularly for military purposes. The extensive use of spacecraft for various military missions is indicated in table 9.1 which shows the yearly launches of various spacecraft since 1958. This summary does not, however, indicate the many satellites launched for basic scientific measurements which may also be of considerable interest to the military. Some 75 per cent of all satellites are launched for military purposes; if we include a number of the scientific satellites, the proportion would be higher. The yearly launch rates of US and Soviet satellites, for most missions, have become constant during the last four years suggesting that the two powers now have as much satellite capacity as they want. Details of the military satellites launched during 1981 are given in tables 9.2–9.9.

Advances made in military space technology include improved space-based sensors for surveillance, communications, command and control systems and space-based navigation aids to enhance the accuracies of delivery systems for both conventional and nuclear weapons. This advanced technology has contributed to refine war-fighting tactics. Over the past two decades or so nuclear war-fighting doctrines have evolved from mutual assured destruction (MAD) to the more unified concept of the countervailing strategy. While the former postulated a concept of massive retaliation against cities and industrial centres, the latter requires the maintenance of MAD capability as well as the ability "for flexible, controlled use of strategic weapons against appropriate targets for any attack at any level of conflict" [1]. The targets are mainly military rather than civilian. The new concept also assumes that "nuclear exchanges might not be quick exchanges but that they might last weeks or even months [2]".

High accuracies of weapon delivery systems, a precise knowledge of targets and adequate warning of attack are among the essential requirements of the new doctrine, while a flexible response capability requires secure communications, command, control and intelligence, so-called C^3I, systems. The extent to which satellites fulfil some of these requirements is briefly discussed below.

As the military has come to rely more and more upon satellites so their survivability has become increasingly threatened. Spacecraft are potential targets for anti-satellite (ASAT) systems. The current status of this aspect of space technology is briefly considered in section III.

II. The role of satellites in nuclear war strategy

The concepts of counterforce and countervailing strategies have only recently been publicly mentioned. But, at least in the USA, these ideas had been expressed as early as 1975 by the then Secretary of Defense James Schlesinger. He said that with "a reserve capability for threatening urban-industrial targets, with offensive systems capable of increased flexibility and discrimination in targeting, and with concomitant improvements in sensors, surveillance, and command-control, we could implement response options that cause far less civilian damage than would now be the case" [3].

Increased flexibility and discrimination in targeting are dependent upon an accurate knowledge of the targets and their locations. One of the factors which decrease collateral damage is the improved accuracy with which weapons could be delivered to their targets. Rapid transmission of targeting information and information directing the actions of the offensive forces needs command, control and communications systems. Space plays an essential role in these processes and the way in which the satellites perform their tasks is indicated below.

Reconnaissance satellites

If photographic, electronic and ocean surveillance and early-warning satellites are included in the reconnaissance satellite group, then they constitute about 50 per cent of all the military satellites launched during 1981 (see table 9.1).

Photographic reconnaissance satellites

The US budget for reconnaissance and surveillance from space is expected to be $1 180 million in FY 1982 and about $1 310 million in FY 1986 [4]. Considerable effort is being devoted to improving sensors such as infra-red devices and radars and to developing long-lived reconnaissance satellites. While both the USA and the USSR have such programmes, the former has actually deployed long-lived photographic reconnaissance satellites. For example, a US satellite (1978-60A) launched on 14 June 1978 had a lifetime of 1 166 days. While these satellites, known as KH-11 satellites, transmit images in real time in digital form to a ground station, the previous generation of spacecraft, the US Big Bird satellites, take photographs of the Earth's surface using high-resolution film cameras.

The films are returned to Earth for processing and analysis. The lifetimes of the Big Bird satellites have been about 180 days, but a more recent satellite (1980-52A) launched on 18 June 1980 decayed after 261 days.

Figure 9.1 shows the extent to which US and Soviet long-lived satellites have observed the earth since 1977. There is considerable overlap between the coverage of individual KH-11 satellites and that between KH-11 and Big Bird satellites. Such an overlap is also beginning to take place in the case of relatively long-lived Soviet satellites. It is interesting to ask why these overlaps occur, particularly when both types of satellite seem to be generating high resolution data. To some extent the answer can be deduced from the orbital characteristics of these satellites.

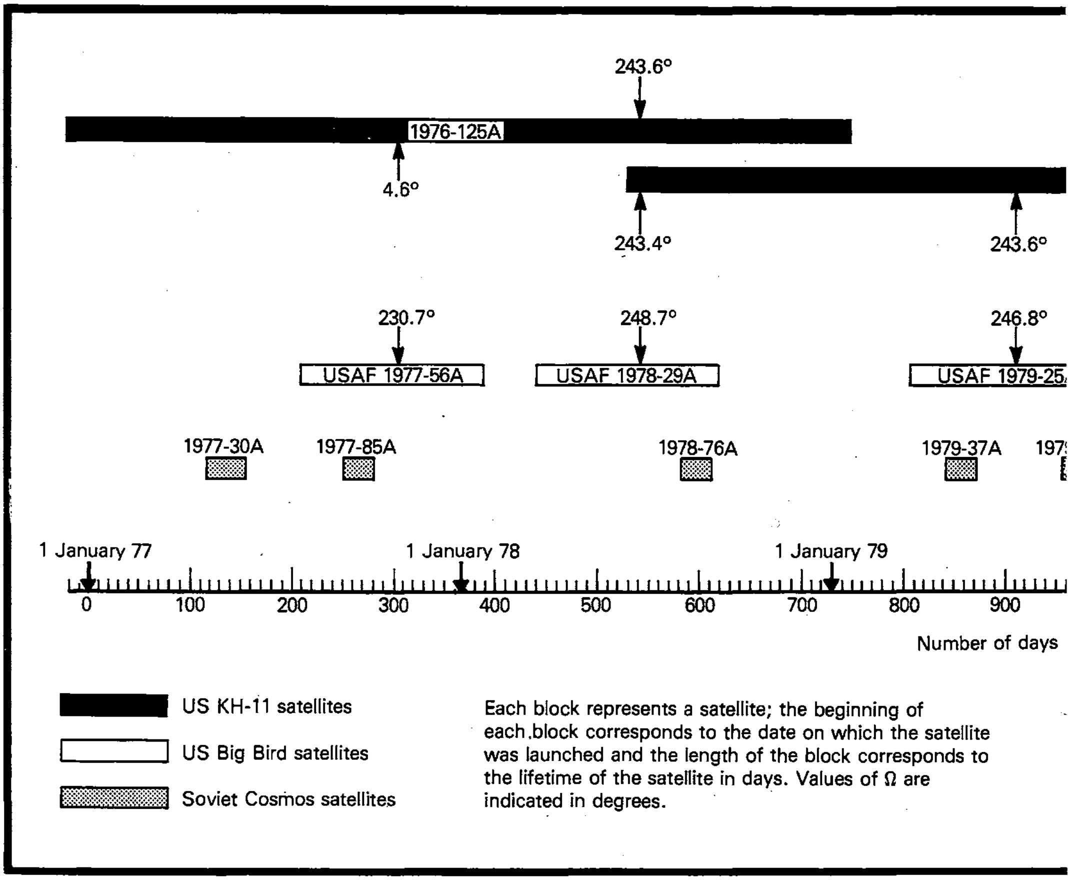
The conclusion is that, first, with more than one satellite in orbit the frequency of observation of any particular area is increased; whereas with one satellite the interval before the next observation is 92 minutes, with two satellites this time would be reduced considerably depending on the relative positions of the orbital planes. Second, because the orbits are spaced, a much larger part of the Earth's surface is covered at the same time. A satellite orbit can be fixed in space by two of the orbital elements,[1] the angle of inclination (i) of the orbital plane of the satellite to the earth's equatorial plane and the right ascension of the ascending node (Ω). (Detailed explanations of the various orbital elements can be found elsewhere [5, 6].) Here it is sufficient to note that in general all the orbital elements except i vary during the lifetime of a satellite. For an orbital inclination of 90°, however, the value of Ω does not change. For US reconnaissance satellites launched with an orbital inclination of about 97°, Ω does not change significantly.

The US satellites considered in figure 9.1 all have very similar orbital inclinations, that is, about 97°. The relative orientations of their orbital planes are, therefore, determined by Ω, the values of which are indicated in figure 9.1 for particular times.

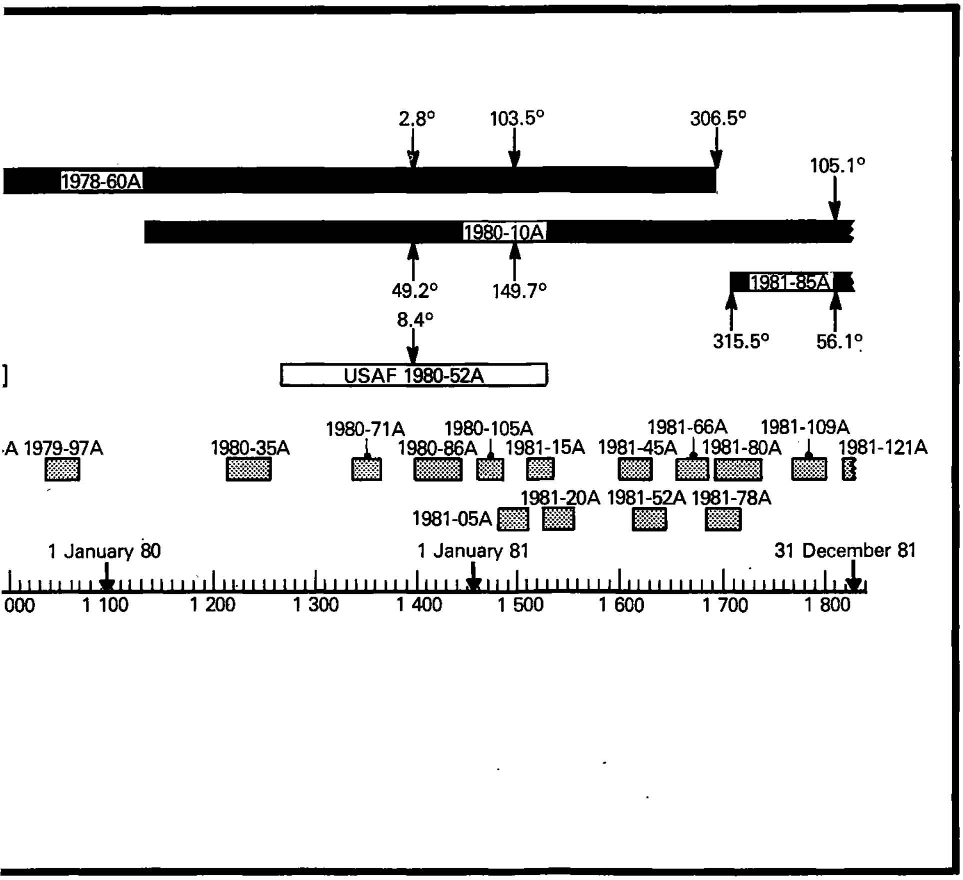
The values of Ω for the KH-11 satellites 1976-125A and 1978-60A are seen from figure 9.1 to be very similar suggesting that satellite 1978-60A was probably a replacement for 1976-125A. The overlap between KH-11s 1978-60A and 1980-10A is for a very long period of time. The difference in Ω for these satellites is 46°. A similar difference (49°) in the values of Ω can be observed between KH-11s 1980-10A and 1981-85A. The latter satellite was launched some 10 days after 1978-60A had decayed. The difference in the values of Ω for these two satellites is not very large (about 9°) suggesting that 1981-85A may have been a replacement for 1978-60A. Since the launch of satellite

[1] The orbital elements are a set of six parameters defining the orbit of a satellite. These are the right ascension of the ascending node (Ω), the orbital inclination (i), the argument of the perigee (ω), the semi-major axis of the orbit (a), the eccentricity of the orbit (e) and the time of perigee passage (T).

Figure 9.1. Coverage by US and Soviet long-lived photographic reconnaissance satellites launched during 1977–81



1980-10A in early 1980, with the exception of some 10 days in 1981, two KH-11 reconnaissance satellites have been in orbit at the same time which suggests that a new two-satellite pattern has been established. This is apparent from figure 9.2 in which the ground tracks obtained over a period of 24 hours for satellites 1980-10A and 1981-85A are plotted. From the figure it can be seen that the gap between two consecutive tracks of satellite 1980-10A is filled in by a ground track of satellite 1981-85A thus increasing the frequency of observation. A wider coverage of the Earth at any given time is also possible because the orbits are spaced (in this case by 49° and in the case of KH-11s 1978-60A and 1980-10A by some 46°) such that a pair of satellites can observe different parts of the Earth's surface simultaneously.



From the values of Ω (see figure 9.1) no clear pattern emerges in the relationship between KH-11 and Big Bird satellites. This may be because KH-11 satellites are operated by the CIA while the US Air Force is in charge of the Big Bird satellites. It is, however, possible that the Big Bird satellites are used to obtain photographs of areas which the KH-11 spacecraft indicate to be of specific interest.

While the sensors on board the KH-11 satellites are sophisticated, highest quality images can probably still be obtained only by using photographic equipment. The Big Bird satellites carry such equipment. In fact, there have been reports suggesting that photographs taken from US satellites have shown a new Soviet variable-geometry swept-wing aircraft [7]. Such are the details observable from space.

The above analysis is confined to US satellites: it is not possible to make similar observations of Soviet satellites because the USSR has still not launched any very long-lived satellites. The majority of Soviet satellites have a lifetime of 14 days. In 1981, however, 10 long-lived satellites were launched, most having lifetimes of about 30 days and three with lifetimes of over 40 days. This was five more long-lived satellites than in 1980. Moreover, since the Soviet reconnaissance satellites are launched at an orbital inclination of about 67°, the rate of change of Ω is not zero. In any case, the extent of overlap is relatively small. The pattern in which these satellites have been launched can be seen from figure 9.1.

Electronic reconnaissance satellites

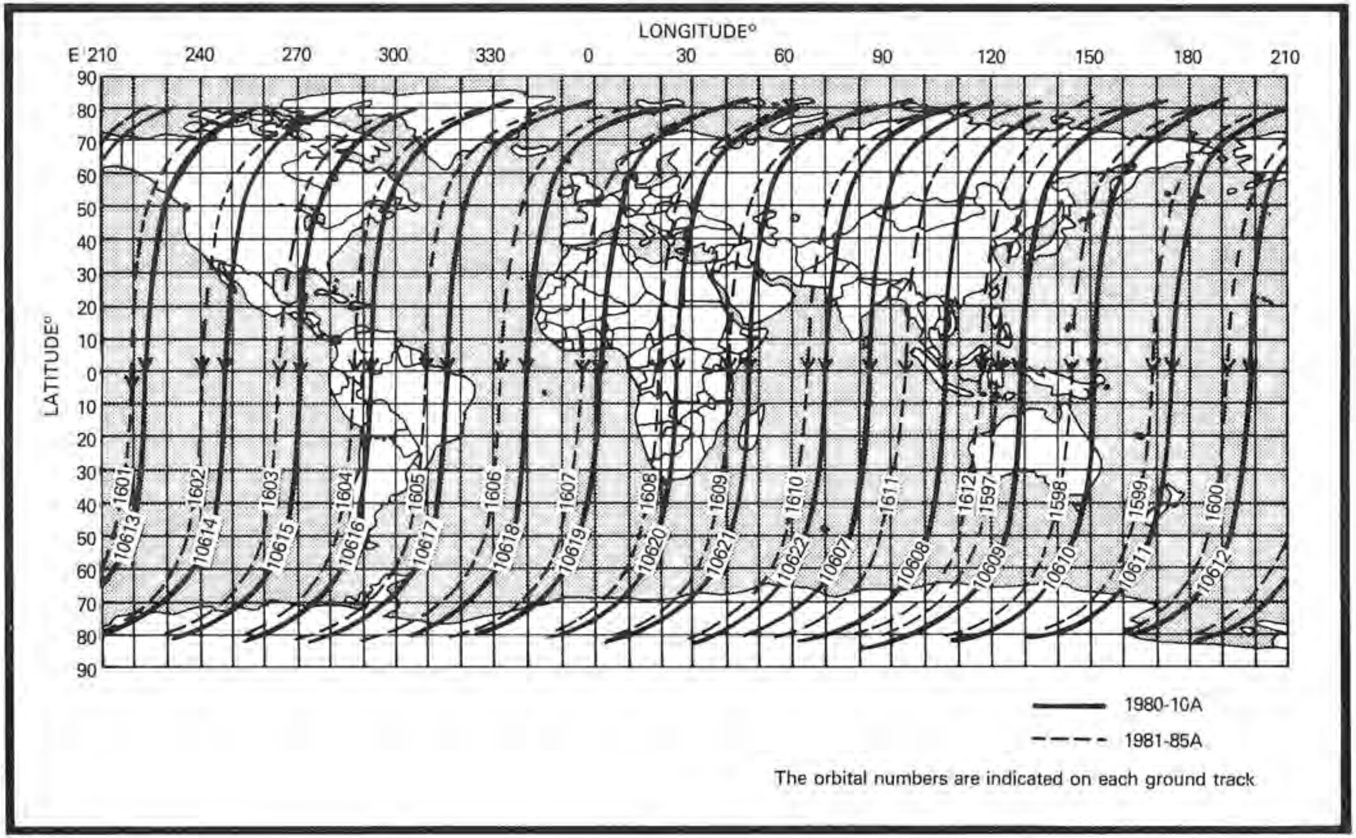
While much is known about photographic reconnaissance satellites, knowledge of electronic surveillance spacecraft is comparatively scant. Clearly, such satellites act as ears in space for the military. They are designed to detect and monitor radio signals generated by the enemy's military activities both within their country and throughout the world. Signals originate from military communications between bases, from early-warning radars, air-defence and missile-defence radars or from those used for missile control. These satellites also gather data on missile testing, new radars and many other types of communications traffic.

It is important to locate precisely the sources of the signals intercepted by electronic reconnaissance satellites. This task could be performed by navigation satellites [8] by a method resembling hyperbolic navigation [9]. The process is reversed and instead of using four transmitters on four satellites to establish the position of a known object, four receivers on four satellites are used to locate the position of an unknown transmitter on the Earth's surface.

Both the USA and the USSR are known to have launched electronic reconnaissance satellites. The US Air Force introduced the first generation of such satellites in 1962 while the first Soviet electronic reconnaissance satellite was launched in 1967. A difference is that, while the US electronic satellites are mainly launched on board Big Bird satellites, the Soviet satellites are still launched by means of independent launchers. The Big Bird passengers are ejected into independent orbits at much greater altitudes. No such satellite was launched in 1981.

In recent years the Soviet Union has launched electronic reconnaissance satellites at orbital inclinations of 74° and with orbital periods of 95.2 minutes. Those launched at orbital inclinations of 81° and with periods of about 97.6 minutes were previously thought to be meteorological satellites, but these are now thought to belong to the electronic reconnaissance series of satellites. A satellite launched in 1981, Cosmos 1311,

Figure 9.2. Southbound ground tracks of two KH-11 satellites (1980-10A and 1981-85A) for a period of 24 hours, showing the frequency of observation when two satellites are used



at an orbital inclination of about 83° with a period of 94.5 minutes may be the start of a new series [10] (see table 9.3).

Besides these electronic reconnaissance satellites, the Soviet Union appears to be using others with orbital inclinations of 65° and orbital periods of 93.3 minutes for ocean surveillance. These satellites detect and monitor radio transmissions and radar signatures probably originating from naval surface ships [10] (see table 9.4).

Other satellites

Other satellites in the intelligence part of the C^3I system are ocean surveillance and oceanographic satellites, early-warning satellites and nuclear explosion detection satellites. Ocean surveillance satellites detect and track military surface ships while oceanographic satellites are used to determine various ocean properties in order to enhance understanding of the behaviour of sound in oceans, a knowledge of which would increase anti-submarine warfare capabilities. The early-warning satellites detect missiles soon after they are launched (see table 9.5).

The USA has launched satellites for the specific detection of nuclear explosions in the atmosphere and in outer space. However, it is now planned that NAVSTAR will carry sensors for this mission under the Integrated Operational Nuclear Detection System (IONDS). This system is intended to provide damage assessment both within one's own country and within enemy territories during and after a nuclear attack. This effort is to support the new nuclear war doctrine which requires early warning of attack, information for assessing the size of the attack and data on the attacked target so that an appropriate response could be made [2].

Communications satellites

Communications satellites are only part of an elaborate communications system. However, in the USA the Department of Defense has preferred satellite communications and has proposed improved communications with the nuclear forces [2]. The existing space component in the US communications system consists of communications transponders aboard satellites such as the Fleet Satellite Communications (FLTSATCOM) satellites, as well as other satellites in polar orbits. The latter satellites are, for example, the Defense Satellite Communications System and the Satellite Data System satellites (see table 9.7).

Since satellites are becoming an essential element of the C^3I system, it has become important to make them survivable. The US Air Force has proposed a satellite for this specific purpose, called STRATSAT, which would orbit at an altitude of about 203 720 km in order to increase its survivability. To improve its resistance to electronic jamming and disturbance of the electromagnetic environment, the satellite would use extra high frequencies and sophisticated electronic methods. It is also proposed that the satellite should have manoeuvring capabilities [2]. While these measures may make satellites survivable and operable, the ground segment of the system, and to some extent the satellites themselves, may suffer considerable damage from the effects of nuclear detonations. Electronic systems could be disrupted without a direct hit by a nuclear warhead.

A nuclear detonation produces, among other effects, a pulse of high-energy gamma rays which would mainly affect semi-conductor devices, a pulse of neutrons which would significantly and permanently alter the electrical properties of semi-conductor devices and an electromagnetic pulse (EMP) which would produce very high voltages and currents in cables, metal enclosures and structures thus causing breakdown in insulations and the destruction of electronic circuits. The electromagnetic pulse would affect very wide areas on the Earth's surface if a nuclear weapon were detonated above the atmosphere, and electronic systems would be incapacitated.

This damage could be reduced to some extent by hardening electronic components at the design stage. Considerable efforts are being devoted to harden both the ground and the space segment of the C^3I [2].

III. ASAT systems

While on one hand considerable resources are devoted to making one's own satellites survivable, much is being done to develop methods of destroying the enemy's spacecraft. In fact the Soviet Union launched three test satellites in 1981; one was a target satellite and the other two were interceptors. These tests were of the co-orbital type in which the interceptors were almost in the same orbital plane as the target. The interceptors approached the target slowly, each coming within a distance of 10 km before de-orbiting and re-entering the earth's atmosphere. In other tests in the past the Soviet Union has orbited the target and the interceptor in different orbital planes, with the interceptor in an eccentric rather than a circular orbit. In this case the interceptor was exploded after the interception. In a third method, the interceptor ascends close to the target and the interception is made before the interceptor has completed a full orbit. The interceptor is then commanded back to Earth.

The USA is planning to begin operational testing of its ASAT system in 1983 and may achieve initial operational status by 1985 [11]. The system consists of a two-stage solid-propellant missile carrying a non-nuclear warhead called the miniature homing vehicle (MHV) designed to damage the enemy satellite. Such missiles will be launched from F-15 aircraft flying at an altitude of some 20 km.

Initial testing of this system on the ground has already begun [12]. The MHV is just under 5.5 m long, 0.5 m in diameter and weighs about 1 180 kg. The first stage of the missile is a booster of a short-range attack missile and the second stage is a smaller Altair 3 solid rocket motor. The MHV is mounted on the frame of the second stage of the missile. Since it is not confined to any specific launch pad on earth this ASAT system has considerable advantages over the Soviet system. It can be used as a direct ascent system against satellites in any orbital inclination. This flexibility together with the small size of the MHV increases its survivability.

The MHV will be guided to its target by an infra-red homing device. It has recently been reported that the Soviet Union has deployed such infra-red homing interceptors on an anti-satellite battle station in low earth orbit [13], but the Pentagon has denied this possibility [14].

Besides these systems, both the USA and the USSR are investigating high-energy laser and particle beams for ASAT applications. For example, in 1982 the USA is expected to spend $279 million on research with the intention of producing high-energy laser weapons [15]. The Department of Defense has been working on laser weapons for over a decade and by the end of fiscal year 1981 will have spent about $1 500 million on investigations into laser weapons. Similar efforts must have been carried out in the USSR.

In early February 1981, the US Air Force tested its aircraft-mounted laser weapon at full power on the ground [16]. Later, on 1 June, the airborne laser weapon was tested against an air-launched AIM-9L Sidewinder air-to-air missile. While the beam hit the target, it did not successfully destroy it [17]. This Airborne Laser Laboratory is equipped with a 400-kW gas dynamic laser operating at a wavelength of 10.6 μm in the infra-red region of the electromagnetic spectrum. Two days later a second test was carried out against an AIM-9L missile. It was reported that this second test had achieved better results because the beam was able to lock on to the target for a long period [18]. While there are a number of technical problems to be solved it appears that, at least in the USA, the nature of laser beam propagation is reasonably well understood [15]. The US Defense Advanced Research Projects Agency is now going to focus its study on the effects of high-energy laser beams on targets such as aircraft and other types of vehicle. The Department of Defense is studying the high-energy laser weapons under two demonstration projects: one is the US Air Force's Airborne Laser Laboratory and the other is the Navy's Sea Lite. The latter uses a chemical laser considerably more powerful than the device used by the former.

IV. Control of the militarization of outer space

From this brief description of the development of military activities in outer space, it is not surprising that both the USSR and the USA have shown at least some interest in limiting their ASAT activities. Both parties, in fact, met once in 1978, then in January 1979 and again from April to June 1979 to discuss the control of their ASAT programmes. The discussions did not seem to have been very productive and no further meetings have taken place.

However, since these talks, a significant move made by the Soviet Union in 1981 appears to have removed the discussions from the bilateral forum to the multilateral one. In August 1981, the USSR proposed to the United Nations a new treaty banning the placement of any kind of weapon into orbit around the Earth [19]. (See also chapter 14.)

However, while the proposal clearly bans the deployment of ASAT weapons in orbit, it does not ban such weapons within the atmosphere and above it. Examples of such weapons are the US MHV system and the Soviet ASAT satellites which do not complete an orbit. While these are some of the drawbacks of the Soviet proposal, nevertheless, it contains some far-reaching measures compared to the 1967 Outer Space Treaty.

In its verification clause the proposal states that "each state party shall use the national technical means of verification at its disposal" to provide assurances of compliance with the provisions of the treaty. Since only two nations today possess the necessary technological base needed for verification, however, it is difficult to visualize many nations becoming parties to the treaty unless an international verification agency is created, as was proposed by France in 1978.

During the 1978 special session of the United Nations General Assembly on disarmament, France proposed the setting up of an International Satellite Monitoring Agency (ISMA). The General Assembly requested the Secretary-General to undertake, with the assistance of qualified governmental experts, a study on the technical, legal and financial implications of establishing an ISMA. The results of the study have since been published [20]. The main conclusions of the report are that: (*a*) space technology would allow observations from satellites for the verification of compliance with arms control and disarmament treaties and for monitoring crisis areas on Earth; (*b*) there is no provision in any international law that would prevent an international government agency from carrying out observations by satellite; and (*c*) the financial burden of the agency in its final phase, when it launches and operates its own satellites and carries out data processing and analysis, is expected to be about $1 500 million (for one satellite) spread over a 10-year period. In any case the annual cost of an ISMA to the international community would be very much less than 1 per cent of the total yearly expenditure on armaments.

The first conclusion is based on the fact that the capabilities of civilian space technology for observing the Earth's surface are beginning to approach those of military technology in many respects. Moreover, satellite technology is spreading into many more countries and launcher technology has reached countries not otherwise considered to be very advanced in this field (see table 9.10). More importantly these countries are also acquiring the technology for image processing, essential for the interpretation of data from space [21]. Undoubtedly these trends will continue and space technology will spread beyond the industrial nations. Once many states are able to observe the Earth from space, the fear of releasing sensitive data—one of the most serious objections to establishing an ISMA—may no longer be relevant.

There are a number of issues to be resolved before an ISMA could be created. Verification could not be carried out from space alone and data from other sources would be necessary. A number of existing international organizations could be involved in the verification of some specific arms control/disarmament treaty, such as the World Health Organization, the World Meteorological Organization, the International Atomic Energy Agency and the International Telecommunications Union [21]. Difficult questions concerning the modalities of data acquisition and dissemination, of direct relevance to the sensitive security considerations of states, must be dealt with. However, solutions to such problems will not be found unless discussions continue. These discussions may even consider the possibilities of a verification agency on a multinational or regional basis. For example, once the Ariane launcher becomes routinely available, the European Space Agency (ESA)[2] could contribute to the verification of any arms control measures that may be worked out in Europe. In this context Interkosmos[3] could also have a vital role to play.

V. Discussions

Both the Soviet and the US military authorities are beginning to depend heavily on artificial Earth satellites. Successful launches of the US reusable

[2] Belgium, Denmark, France, the Federal Republic of Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the UK are members of the European Space Agency.

[3] Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the USSR are members of Interkosmos.

launcher, the Space Transportation System or space shuttle, in 1981 have opened up the door for further proliferation of military activities in outer space. The US Air Force has suggested it should have more control over the future activities of the space shuttle [22]. It has also been suggested that under the Block II shuttle programme the capabilities of the space shuttle should be increased by enlarging the vehicle to accommodate larger payload.

The second shuttle launch, *Columbia 2*, on 12 November 1981 was a significant one. First, it showed that a space transportation vehicle could be used again and, second, it carried a number of test payloads which increased the mass lifted into orbit relative to the previous launch in April 1981. The test payloads included a manipulator arm to be used later for placing satellites into orbit and retrieving satellites from orbit for inspections and repair. Under the OSTA-1 programme (Office of Space and Terrestial Applications) the Shuttle Image Radar-A (SIR-A) and Shuttle Multispectral Infra-red Radiometer (SMIRA) were also carried. *Columbia 2* was placed in a circular orbit at an altitude of about 250 km with an orbital inclination of 38°. It orbited in an inverted position with its cargo bay doors facing the Earth and open. The SIR-A and the SMIRA functioned successfully [23]. The ground resolution of SIR-A, the first side-looking radar to be orbited, is expected to be about 80 m (or an instantaneous field of view (IFOV) of 40 m × 40 m) [24].

During 1981, the virtual monopoly of the USA and the USSR for launching spacecraft was broken by the European Space Agency's successful launch (using a single Ariane launcher) of two satellites, the European Weather Satellite, *Meteosat*, and the Indian communications satellite, *Apple*. In 1981, the People's Republic of China also launched three satellites using a single launcher. This came after a lull of some three years.

Improvements in space-based sensors for surveillance, communications, command and control systems and space-based navigation technology to enhance the accuracies of delivery vehicles for both conventional and nuclear weapons are relevant not only to the current nuclear arms race but also to war-fighting strategies. This link between the arms race on earth and space technology is further emphasized by the fact that nuclear weapon states orbit spacecraft by means of launchers based on missiles developed to carry nuclear warheads. In a separate trend some countries outside the group of nuclear weapon states have developed launchers primarily for orbiting satellites. It will be an opportunity missed if greater control over the militarization of space is not brought about now. In this context it is essential that discussions of concepts such as ISMA be kept alive and an improved outer space treaty be worked out.

VI. Tables

Table 9.1. Summary of possible military satellites by type of mission

	Photographic reconnaissance satellites			Electronic reconnaissance satellites		US MIDAS and Vela satellites		Early-warning satellites		Ocean-surveillance satellites		Navigation satellites	
Year	USA	USSR	China	USA	USSR	MIDAS	Vela	USA	USSR	USA	USSR	USA	USSR
1958	–	–	–	–	–	–	–	–	–	–	–	–	–
1959	6	–	–	–	–	–	–	–	–	–	–	1	–
1960	6	–	–	–	–	2	–	–	–	–	–	2	–
1961	13	–	–	–	–	3	–	–	–	–	–	3	–
1962	26	5	–	4	–	1	–	–	–	–	–	1	–
1963	17	7	–	7	–	2	2	–	–	–	–	3	–
1964	24	12	–	8	–	–	2	–	–	–	–	3	–
1965	21	17	–	5	–	–	2	–	–	–	–	4	–
1966	23	21	–	10	–	2	–	1	–	–	–	4	–
1967	18	22	–	8	5	–	2	–	1	–	1	3	–
1968	16	29	–	7	7	–	–	1	1	–	1	1	–
1969	12	32	–	6	11	–	2	1	–	–	–	–	–
1970	9	29	–	7	10	–	2	3	–	–	1	1	1
1971	7	28	–	3	15	–	–	1	–	4	2	–	2
1972	8	30	–	3	7	–	–	2	1	–	1	1	3
1973	5	35	–	2	12	–	–	2	1	–	1	1	3
1974	5	28	–	3	10	–	–	–	1	–	2	1	4
1975	4	34	1	2	8	–	–	2	2	1	3	1	4
1976	4	34	1	1	11	–	–	1	1	4	2	1	8
1977	3	33	–	–	8	–	–	2	3	4	3	1	8
1978	2	35	1	1	6	–	–	2	2	1	–	4	8
1979	2	35	–	1	5	–	–	2	2	–	3	–	6
1980	2	35	–	1	6	–	–	–	5	4	4	2	6
1981	2	37	–	–	4	–	–	2	5	–	8	1	5
Total by country	**235**	**538**	**3**	**79**	**125**	**10**	**12**	**22**	**25**	**18**	**32**	**39**	**58**
Total by mission		**776**		**204**		**22**		**47**		**50**		**97**	

[a] Fractional orbital bombardment system.

Communications satellites					Meteorological satellites				Geodetic satellites			FOBSs[a]	Interceptor/ destructor satellites		
USA	USSR	NATO	UK	France	USA	USSR	France	UK	USA	USSR	France	USSR	USSR	Yearly total	Cumulative total
1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	8
2	–	–	–	–	2	–	–	–	–	–	–	–	–	14	22
2	–	–	–	–	1	–	–	–	–	–	–	–	–	22	44
3	–	–	–	–	4	–	–	–	1	–	–	–	–	45	89
4	–	–	–	–	3	2	–	–	–	–	–	–	–	47	136
3	3	–	–	–	3	2	–	–	2	–	–	–	–	62	198
7	8	–	–	–	6	4	–	–	6	–	–	–	–	80	278
11	2	–	–	–	6	2	–	–	4	–	1	2	–	89	367
17	5	–	–	–	6	4	–	–	1	–	2	9	1	105	472
11	4	–	–	–	4	2	–	–	1	2	–	2	4	93	565
5	2	–	1	–	3	2	–	–	1	2	–	1	2	83	648
3	14	1	1	–	5	6	–	–	1	–	1	2	3	100	748
5	21	1	–	–	2	4	1	1	–	2	–	1	6	106	854
3	24	–	–	–	4	5	–	–	–	2	–	–	–	94	948
4	33	–	–	–	2	3	–	–	–	1	–	–	–	105	1 053
3	24	–	2	1	4	6	–	–	–	2	–	–	–	96	1 149
5	37	–	–	1	3	5	–	–	1	2	1	–	–	117	1 266
11	29	1	–	–	3	3	–	–	1	1	–	–	1	118	1 384
4	16	1	–	–	2	3	–	–	–	1	–	–	7	99	1 483
6	42	1	–	–	4	–	–	–	–	1	–	–	1	117	1 600
3	27	–	–	–	2	4	–	–	–	–	–	–	2	94	1 694
3	36	–	–	–	2	2	–	–	–	–	–	–	3	111	1 805
2	39	–	–	–	2	2	–	–	–	–	–	–	3	112	1 917
118	**366**	**5**	**4**	**2**	**73**	**61**	**1**	**1**	**19**	**16**	**5**	**17**	**33**	**1 917**	
		495					**134**			**40**		**17**	**33**	**1 917**	

Table 9.2. Photographic reconnaissance satellites launched during 1981[a]

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USA				
USAF (1981-19A)	28 Feb 1912	96.38 89.25	138 336	Lifetime 112 days; T-3B/A-D close look satellite
Titan 3D (1981-85A)	3 Sep 1829	96.99 92.27	244 526	Manoeuvrable; probably a KH-11 digital imaging satellite
USSR				
Cosmos 1237 (1981-01A)	6 Jan 1214	72.88 90.35	195 387	Lifetime 14 days; subsequently orbited at high perigee
Cosmos 1239 (1981-04A)	16 Jan 1200	82.33 89.03	216 234	Lifetime 12 days; geodetic and mapping; non-manoeuvrable
Cosmos 1240 (1981-05A)	20 Jan 1102	64.88 89.77	171 357	Lifetime 28 days; fourth generation; high resolution
Cosmos 1245 (1981-14A)	13 Feb 1117	72.84 92.28	356 416	Lifetime 14 days; high perigee
Cosmos 1246 (1981-15A)	18 Feb 0907	64.90 89.91	198 272	Lifetime 23 days; fourth generation; high resolution
Cosmos 1248 (1981-20A)	5 Mar 1507	67.14 89.68	173 345	Lifetime 30 days; fourth generation; high resolution
Cosmos 1259 (1981-26A)	17 Mar 0836	70.35 90.43	208 383	Lifetime 14 days; high perigee; TF recovery beacon
Cosmos 1262 (1981-32A)	7 Apr 1048	72.87 90.42	197 393	Lifetime 14 days; high resolution; manoeuvrable
Cosmos 1264 (1981-35A)	15 Apr 1033	70.37 90.48	208 388	Lifetime 14 days; subsequently orbited at high perigee; TF recovery beacon
Cosmos 1265 (1981-36A)	16 Apr 1131	72.85 89.65	226 288	Lifetime 12 days; high resolution; manoeuvrable; TF recovery beacon
Cosmos 1268 (1981-40A)	28 Apr 0907	70.38 90.30	210 358	Lifetime 14 days; high resolution; manoeuvrable; TF recovery beacon
Cosmos 1270 (1981-45A)	18 May 1200	64.86 89.71	173 349	Lifetime 30 days; fourth generation; high resolution
Cosmos 1272 (1981-47A)	21 May 0922	70.39 92.35	362 417	Lifetime 14 days; high perigee
Cosmos 1273 (1981-48A)	22 May 0712	82.30 89.27	210 264	Lifetime 13 days; high resolution; Earth resources; data received by Priroda Nature Station
Cosmos 1274 (1981-52A)	3 Jun 1410	67.15 89.77	172 355	Lifetime 30 days; fourth generation; high resolution
Cosmos 1276 (1981-55A)	16 Jun 0658	82.37 89.07	216 239	Lifetime 13 days; earth resources; TK recovery beacon
Cosmos 1277 (1981-56A)	17 Jun 0936	70.41 90.39	208 379	Lifetime 14 days; subsequently orbited at high perigee
Cosmos 1279 (1981-62A)	1 Jul 0936	70.39 90.27	212 363	Lifetime 14 days; high resolution; manoeuvrable; TF recovery beacon
Cosmos 1280 (1981-63A)	2 Jul 0712	82.31 89.50	211 286	Lifetime 14 days; high resolution; Earth resources; data received by Priroda Nature Station

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
Cosmos 1281 (1981-64A)	7 Jul 1229	72.84 90.44	197 394	Lifetime 14 days; subsequently orbited at high perigee; TF recovery beacon
Cosmos 1282 (1981-66A)	15 Jul 1312	64.92 89.59	173 337	Lifetime 30 days; fourth generation; high resolution
Cosmos 1283 (1981-67A)	17 Jul 0810	82.34 88.84	182 250	Lifetime 14 days; subsequently orbited at high perigee; Earth resources[b]; TF recovery beacon
Cosmos 1284 (1981-68A)	29 Jul 1326	82.33 88.76	183 241	Lifetime 14 days; subsequently orbited at high perigee; Earth resources[b]; TF recovery beacon
Cosmos 1296 (1981-78A)	13 Aug 1919	67.14 89.77	172 354	Lifetime 31 days; fourth generation; high resolution
Cosmos 1297 (1981-79A)	18 Aug 0936	72.86 90.15	199 364	Lifetime 12 days; high resolution; manoeuvrable
Cosmos 1298 (1981-80A)	21 Aug 1019	64.89 89.54	174 331	Lifetime 42 days; fourth generation; high resolution
Cosmos 1301 (1981-83A)	27 Aug 1033	82.31 89.38	213 272	Lifetime 14 days; high resolution; Earth resources; TF recovery beacon
Cosmos 1303 (1981-86A)	4 Sep 0810	70.40 90.36	208 376	Lifetime 14 days; subsequently orbited at high perigee; TF recovery beacon
Cosmos 1307 (1981-90A)	15 Sep 1131	72.86 90.44	198 394	Lifetime 14 days; subsequently orbited at high perigee; TF recovery beacon
Cosmos 1309 (1981-92A)	18 Sep 0936	82.30 89.22	212 257	Lifetime 13 days; geodetic and mapping; non-manoeuvrable; TL recovery beacon
Cosmos 1313 (1981-99A)	1 Oct 0907	70.36 89.48	206 291	Lifetime 14 days; high resolution; manoeuvrable; TF recovery beacon
Cosmos 1314 (1981-101)	9 Oct 1048	82.34 89.03	214 237	Lifetime 13 days; high resolution; Earth resources; data received by Priroda Nature Station; TK recovery beacon
Cosmos 1316 (1981-104A)	15 Oct 0922	70.36 90.46	209 385	Lifetime 14 days; high resolution; TF recovery beacon
Cosmos 1318 (1981-109A)	3 Nov 1312	67.14 89.75	172 353	Lifetime 31 days; fourth generation; high resolution
Cosmos 1319 (1981-112A)	13 Nov 0936	70.36 90.38	209 377	Lifetime 14 days; high perigee; TF recovery beacon
Cosmos 1329 (1981-118A)	4 Dec 0950	65.02 89.45	232 264	Lifetime 14 days; high resolution; TF recovery beacon
Cosmos 1330 (1981-121A)	19 Dec 1200	70.36 89.99	168 379	Still in orbit 31 December 1981; fourth generation

[a] Morse code recovery beacon data supplied by the Kettering Group. Satellites with eventual high perigee were manoeuvred after one day, giving a period of 92 minutes; probably performing area surveillance (G. E. Perry, private communication).
[b] These two flights are the only high perigee missions to be specially designated Earth resources satellites (G. E. Perry, private communication).

Table 9.3. Possible electronic reconnaissance satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USSR				
Cosmos 1242[a] (1981-08A)	27 Jan 1507	81.17 97.58	626 658	Lifetime 60 years
Cosmos 1271[a] (1981-46A)	19 May 0350	81.22 97.52	628 650	Lifetime 60 years
Cosmos 1311 (1981-97A)	28 Sep 2234	82.99 94.46	463 519	Lifetime 3 years; may be the start of a new system
Cosmos 1315[a] (1981-103A)	13 Oct 2324	81.19 97.69	627 667	Lifetime 60 years

[a] In previous SIPRI Yearbooks, satellites with orbital inclinations of 81° and periods of about 97.6 minutes were classified as meteorological satellites. These were Cosmos 756, 808, 851, 895, 925, 955, 975, 1005, 1043, 1063, 1077, 1093, 1116, 1143, 1145, 1154, 1184, 1206 and 1222, which belong to the electronic reconnaissance series of satellites.

Table 9.4. Ocean surveillance and oceanographic satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USSR				
Cosmos 1249 (1981-21A)	5 Mar 1814	64.99 89.66	252 265	Nuclear-powered radar; manoeuvres into higher orbit on 1 Jul (65.0°, 103.89 minutes, 898 km × 985 km)
Cosmos 1260 (1981-28A)	20 Mar 2346?	65.03 93.32	425 444	Passive satellite with ion thruster
Cosmos 1266 (1981-37A)	21 Apr 0350	64.97 89.66	249 268	Nuclear-powered radar; manoeuvred into higher orbit on 1 May (64.76°, 103.65 minutes, 891 km × 965 km)
Cosmos 1286 (1981-72A)	4 Aug 0824	65.04 93.33	432 445	Passive satellite with ion thruster
Cosmos 1299 (1981-81A)	24 Aug 1634	65.00 89.65	248 267	Nuclear-powered radar; manoeuvred into higher orbit on 5 Sep (65.12°, 104.00 minutes, 910 km × 984 km)
Cosmos 1300 (1981-82A)	24 Aug 2136	82.50 97.79	638 666	Presumed oceanographic satellite; similar to Cosmos 1076 and 1151
Cosmos 1306 (1981-89A)	14 Sep 2038	64.96 93.28	409 462	Passive satellite with ion thruster
Cosmos 1328 (1981-117A)	3 Dec 1146	82.52 97.77	637 665	Presumed to be oceanographic; similar to Cosmos 1076 and 1151

Table 9.5. Possible early-warning satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USA				
IMEWS-11 (1981-25A)	16 Mar 2107	1.99 1 421.15	35 463 35 527	Placed in geostationary orbit at longitude 71° E
IMEWS-12 (1981-107A)	31 Oct 0936			Orbit similar to 1981-25A
USSR				
Cosmos 1247 (1981-16A)	19 Feb 1131	62.93 707.33	688 39 232	
Cosmos 1261 (1981-31A)	31 Mar 0950	62.95 710.47	589 39 406	
Cosmos 1278 (1981-58A)	19 Jun 1938	62.84 727.43	623 40 213	
Cosmos 1285 (1981-71A)	4 Aug 0014	62.96 727.59	594 40 250	Ground tracks never stabilized; did not separate from escape stage? fragment?
Cosmos 1317 (1981-108A)	31 Oct 2324	62.87 725.73	584 40 163	

Table 9.6. Meteorological satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USA				
NASA/GOES 5 (1981-49A)	22 May 2234	0.51 1 430.10	35 453 35 887	Placed above longitude 85° W in a geosynchronous orbit
NASA/NOAA 7 (1981-59A)	23 Jun 1048	98.90 102.04	845 863	Replaces Tiros-N launched in Oct 1978
USSR				
Meteor 2–7 (1981-43A)	14 May 2150	81.27 102.46	855 893	
Meteor 31 (1981-65A)	10 Jul 0517	97.94 97.56	610 671	

Table 9.7. Communications satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USA				
USAF SDS 7? (1981-38A)	24 Apr –	– –	– –	SDS (Satellite Data System) mission provides data relay functions and supports communications for USAF strategic bombers flying in polar regions; orbit similar to 1980-100A?
FLTSATCOM 5 (1981-73A)	6 Aug 0810	6.33 1 558.08	35 102 41 185	Last in a series of five, intended as an in-orbit spare for four now in operation
USSR				
Molniya 3–14 (1981-02A)	9 Jan 1507	62.80 735.74	439 40 800	Replaces Molniya 3–10
Molniya 1-49 (1981-09A)	30 Jan 1800	62.83 735.65	430 40 805	Probably serving military communications in Siberia and northern USSR; to replace Molniya 1-41
Cosmos 1250 (1981-22A)	6 Mar 1131	74.03 114.51	1 399 1 467	Octuple launch
Cosmos 1251 (1981-22B)	6 Mar 1131	74.02 114.67	1 406 1 474	
Cosmos 1252 (1981-22C)	6 Mar 1131	74.02 114.82	1 420 1 474	
Cosmos 1253 (1981-22D)	6 Mar 1131	74.03 115.18	1 442 1 485	
Cosmos 1254 (1981-22E)	6 Mar 1131	74.03 114.98	1 434 1 474	
Cosmos 1255 (1981-22F)	6 Mar 1131	74.03 115.13	1 448 1 474	
Cosmos 1256 (1981-22G)	6 Mar 1131	74.04 115.30	1 459 1 479	
Cosmos 1257 (1981-22H)	6 Mar 1131	74.03 115.46	1 470 1 482	
Raduga 8 (1981-27A)	18 Mar 0448	0.75 1 475.17	36 551 36 551	Replaces Raduga 6 at Statsionar 2 position at longitude 35° E
Molniya 3-15 (1981-30A)	24 Mar 0336	62.73 736.00	609 40 643	Replaces Molniya 3-11
Cosmos 1269 (1981-41A)	7 May 1326	74.06 100.94	796 810	Possibly the so-called store-dump communications satellite
Molniya 3-16 (1981-54A)	9 Jun 0336	62.81 736.56	434 40 844	Replaces Molniya 3-14
Molniya 1-50 (1981-60A)	24 Jun 1926	62.79 736.13	617 40 641	Replaces Molniya 1-42
Ekran 7 (1981-61A)	26 Jun 2400	0.07 1 426.46	35 599 35 600	At Statsionar T; initial Tass announcement specified Statsionar I but all previous Ekrans have been at Statsionar T

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
Raduga 9 (1981-69A)	30 Jul 2136	0.40 1 476.80	36 582 36 583	Replaces Raduga 8 at Statsionar 2
Cosmos 1287 (1981-74A)	6 Aug 1146	74.03 115.79	1 466 1 515	
Cosmos 1288 (1981-74B)	6 Aug 1146	74.03 115.58	1 468 1 494	
Cosmos 1289 (1981-74C)	6 Aug 1146	74.02 115.37	1 462 1 481	
Cosmos 1290 (1981-74D)	6 Aug 1146	74.03 115.18	1 460 1 466	Octuple launch, Navy tactical communications
Cosmos 1291 (1981-74E)	6 Aug 1146	74.03 115.18	1 460 1 466	
Cosmos 1292 (1981-74F)	6 Aug 1146	74.03 114.83	1 428 1 466	
Cosmos 1293 (1981-74G)	6 Aug 1146	74.03 114.65	1 411 1 467	
Cosmos 1294 (1981-74H)	6 Aug 1146	74.04 114.46	1 395 1 466	
Cosmos 1302 (1981-84A)	28 Aug 1919	74.03 100.83	783 812	Possibly the so-called store-dump communications satellite
Cosmos 1305 (1981-88A)	11 Sep 0853	62.83 263.73	626 13 865	Failure to replace Molniya 3-12 due to under-burn of e-stage
Raduga 10 (1981-102A)	9 Oct 1702	0.07 1 443.95	35 932 35 932	Replaces Raduga 7 at Statsionar 3
Molniya 3-17 (1981-105A)	17 Oct 0600	62.32 736.30	619 40 648	Replaces Molniya 3-12; see Cosmos 1305
Molniya 1-51 (1981-113A)	17 Nov 1536	62.81 702.03	441 39 136	Replaces Molniya 1-39
Cosmos 1320 (1981-116A)	28 Nov 1800	73.97 117.32	1 482 1 638	
Cosmos 1321 (1981-116B)	28 Nov 1800	73.99 117.29	1 482 1 635	
Cosmos 1322 (1981-116C)	28 Nov 1800	73.98 117.26	1 483 1 631	
Cosmos 1323 (1981-116D)	28 Nov 1800	73.98 117.21	1 483 1 627	Octuple launch; each satellite has a period of 117 minutes which is higher than normal for such launches
Cosmos 1324 (1981-116E)	28 Nov 1800	73.99 117.15	1 482 1 623	
Cosmos 1325 (1981-116F)	28 Nov 1800	73.98 117.12	1 483 1 619	
Cosmos 1326 (1981-116G)	28 Nov 1800	73.98 117.12	1 485 1 617	
Cosmos 1327 (1981-116H)	28 Nov 1800	73.99 117.05	1 486 1 609	
Molniya 1-52 (1981-123A)	23 Dec 1326	62.95 699.39	484 13 960	Replaces Molniya 1-45

Table 9.8. Navigation satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USA				
USN Nova-1 (1981-44A)	15 May 0600	89.96 108.90	1 170 1 187	Improved Transit
USSR				
Cosmos 1244 (1981-13A)	12 Feb 1814	82.95 104.90	963 1 014	Replaces Cosmos 1104
Cosmos 1275 (1981-53A)	4 Jun 1536	82.96 104.91	964 1 014	Replaces Cosmos 1141
Cosmos 1295 (1981-77A)	12 Aug 0546	82.92 104.79	952 1 015	Replaces Cosmos 1181
Cosmos 1304 (1981-87A)	4 Sep 1102	82.94 103.99	912 980	Replaces Cosmos 926; orbit not quite nominal
Cosmos 1308 (1981-91A)	18 Sep 0336	82.92 104.86	970 1 004	Replaces Cosmos 1275

Table 9.9. Possible interceptor/destructor satellites launched during 1981

Country, satellite name and designation	Launch date and time (GMT)	Orbital inclination (deg) and period (min)	Perigee and apogee heights (km)	Comments
USSR				
Cosmos 1241 (1981-06A)	21 Jan 0824	65.82 104.97	977 1 011	ASAT target; orbital height similar to that of Soviet navigation satellites
Cosmos 1243 (1981-10A)	2 Feb 0014	65.82 97.85	297 1 017	Probably passed closer than 8 km to Cosmos 1241 on 2 Feb, then de-orbited; first successful R&D test of a new optical thermal guidance system
Cosmos 1258 (1981-24A)	14 Mar 1702	65.83 98.00	303 1 026	Probably passed closer than 8 km to Cosmos 1241, then de-orbited

Table 9.10. Present status of spacecraft launchers

Country	Launcher name	No. of stages	Type of fuel	Payload (kg) Low orbit (200–1 000 km)	Payload (kg) Synchronous orbit	Cost of launching (million dollars)	First flight
France	Diamant BP-4	4	Liquid and solid	140	..	..	1970
ESA	Ariane	3	Liquid	5 900	526	16	1979
India	SLV-3	4	Solid	40	..	..	1978
Japan	L-4S	4	Solid	12	..	..	1966
	M-4S	4	Solid	75	..	..	1971
	M-3C	3	Solid	160	..	..	1974
	M-3H/ M-3S	3	Solid	270	..	..	..
	N-1	3	Liquid and solid	400	..	..	1975
	N-2	3	Liquid and solid	1 100	..	..	1981
USA	Scout	4	Solid	200	..	5.2	1960
	Delta	3	Liquid and solid	2 040	400	9.2	1960
	Atlas/ Centaur	2	Liquid	4 900	1 800	18.7	1962
	Titan 3C	4	Liquid and solid	11 340	1 450	23.2	1965
	Titan 3D	2	Liquid and solid	13 600	..	..	1971
	Titan 34D	3	Liquid and solid	14 900	1 900	..	Planned for 1981
	Titan 3E/ Centaur	4	Liquid and solid	13 600	3 530	29.3	1974
	Shuttle	2	Solid	1 590	2 270	12–15	1979
USSR	A (SS-6 Sapwood)	2	Liquid	..	..	..	1957
	B (SS-4 Sandal)	2	Liquid	300–420	..	..	1962
	C (SS-5 Skean)	2	..	500–1 000	..	..	1964
	D (Proton)	4	..	13 000–22 500	..	..	1965
	F (SS-9 Scarp)	3	..	2 500–4 700	..	..	1966

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10. The changing status of chemical and biological warfare: recent technical, military and political developments

Square-bracketed numbers, thus [1], *refer to the list of references on page* 355.

I. Introduction

After a period of comparative obscurity during the 1970s, chemical and biological warfare (CBW) are now receiving renewed attention. The reasons do not entirely lie, as they have done on similar occasions in the past, in the emotiveness of poison gas and germ weapons in public opinion, and hence in the ease with which the subject lends itself to political rhetoric. This time around it also reflects a renascent military interest.

This must be judged a most ominous development, on two main grounds. First, because CBW overlaps strongly with both conventional and nuclear warfare, any expansion of CBW capabilities could strengthen the linkages between the two, thereby increasing the probability of nuclear war. Second, there now exists a growing body of new scientific knowledge about the molecular and cellular processes of life which is largely untapped by the military but which, should its exploitation for CBW purposes begin, could both become increasingly difficult to develop for beneficial application and generate hideous new weapons. The present CBW arms control and disarmament regime is one of the few safeguards we have against these threats. But the pressures which are creating the threats are also acting to subvert it.

That such a situation might arise, and the manner in which it might do so, were discussed a decade ago in SIPRI's main publication in this field [1–6]. The pages which follow review the events since then which seem to an observer in the West to be transforming the possibility into a reality. They open with a brief account of the present CBW arms control regime. They then describe what appear to be the main threats to it, under five subheadings, and the responses that the threats have engendered. No conclusions are offered, the facts being left to speak for themselves.

It will be seen that during 1981 the world moved rapidly to the verge of a full-blown chemical arms race that could well place the entire CBW arms control regime in jeopardy and call forth extraordinary new dangers. This development has, for most people, been obscured by the nuclear arms race. But it is precisely because of inattention on the part of people who should have concerned themselves with it that the CBW situation has so

Table 10.1. States which are not yet parties to the 1925 Geneva Protocol or which have limited their obligations under the Protocol by reserving the right to retaliate in kind

Non-parties		Parties that have expressly reserved the right to retaliate in kind: State	Year	States that have not expressly repudiated reservations of the right to retaliate in kind made by their former colonial rulers[c]
Afghanistan	Kiribati	Australia	1930	*Bahamas
Albania	Korea, North	Belgium	1928	*Botswana
Algeria	Korea, South	Bulgaria	1934	*Burma
Angola	Laos	Canada	1930	Cyprus
Bahrain	Liechtenstein	Chile	1935	Gambia
Bangladesh	Mauritania	China	1952	*Grenada
Belize	Mozambique	Czechoslovakia	1938	*Guyana
Benin	Nauru	Fiji	1973	Indonesia
Bolivia	Nicaragua[a]	France	1926	Jamaica
Burundi	Oman	India	1930	Lesotho
Cameroon	Peru	Iraq	1931	Malta
Cape Verde	St Lucia	Israel	1969	Niger
Chad	St Vincent & the Grenadines	Jordan	1977	Pakistan
Colombia	Samoa	Kuwait	1971	Rwanda
Congo	San Marino	Libya	1971	*Seychelles
Costa Rica	Sao Tome & Principe	Mongolia	1968	*Singapore
Dominica	Solomon Islands	Netherlands	1930[b]	*Suriname
El Salvador[a]	Somalia	New Zealand	1930	*Swaziland
Equatorial Guinea	Tuvalu	Nigeria	1968	Trinidad & Tobago
Gabon	United Arab Emirates	Portugal	1930	*Zambia
Guatemala	Vanuatu Republic	Romania	1929	
Guinea	Yemen, Democratic	South Africa	1930	
Guinea-Bissau	Zaire	Soviet Union	1928	
Haiti	Zimbabwe	Spain	1929	
Honduras		United Kingdom	1930	
Kampuchea, Democratic		United States	1975[b]	
		Yugoslavia	1929	

[a] These two states have signed the Geneva Protocol but have not yet ratified their signatures.
[b] The retaliatory use only of chemical weapons was reserved, not biological weapons as well.
[c] This list, for which the cut-off date is 31 December 1979, includes states-parties whose declarations of succession are ambiguous on the matter. It is not clear whether the 10 countries marked with an asterisk (*) are in fact parties to the Protocol at all (see note on sources below). The source which states that they are parties—the USACDA publication—also states that they have reserved the right to retaliate in kind; but it makes no such statement as regards Comoros, Djibouti and Mali, which are the three other countries in this uncertain category.

Sources: This list of non-parties and part-parties is based on the lists of states-parties published by the US Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements* (1980 edition), pp. 15–18, and by SIPRI in *World Armaments and Disarmament: SIPRI Yearbook 1980*, pp. 376–79. Certain inconsistencies between these lists must be noted. The SIPRI list, which comprises parties as of 31 December 1979, includes one state not listed by USACDA (Senegal). The USACDA list, which is dated August 1980, includes 13 states not listed by SIPRI (Bahamas, Botswana, Burma, Comoros, Djibouti, Grenada, Guyana, Mali, Seychelles, Singapore, Suriname, Swaziland and Zambia), apparently because of differences of interpretation on the question of succession to the Protocol by newly independent states. The cut-off dates of the two lists were too early to have included as parties Papua/New Guinea, Sudan and Viet Nam which, as of 1 October 1981, according to the Ministry of Foreign Affairs of France (which is the depository of the Protocol), are the only states to have become parties since 31 December 1979. The position of the latest state to have become independent, Antigua, is not yet known.

deteriorated. 1982 may present the last opportunities we shall have for remedial action.

II. The present CBW arms control regime

Current international law places a wide range of restrictions on CBW activities. No other category of armament has attracted anything like it: testimony, perhaps, to the special abhorrence with which people regard poisons and germs, even, it has been suggested [7], to the existence of some sort of genetically mediated aversion that finds expression in social rules. However, across the entire spectrum of activities that might be associated with CB weapons—including research, development, production, stockpiling, international transfer and actual use—there is variation in the nature and strength of the proscriptions and in the manner in which different governments interpret them. A large gap exists in the absence of any universal international law banning possession of chemical weapons; such laws of this type as there are, a residue of World War II, apply only to a small number of European states (Austria, Bulgaria, Finland, Hungary, Romania and FR Germany) [3a, 4a, 5a].

The cornerstone of the law is the 1925 Geneva Protocol. Between its parties, this treaty outlaws "the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials and devices". It also prohibits "the use of bacteriological methods of warfare". Its proscriptions have now entered customary international law and are thus binding upon all states, not only those that are parties to the Protocol. No formal arrangements exist for international co-operation or consultation in the event of allegations of CBW arising, or for international investigation serving to verify or refute them. The Geneva Protocol provides an absolute ban on use of CB weapons. However, in that it is a contract between its parties, a breach may be taken to nullify the ban, in which case the treaty would, in effect, be merely a no-first-use agreement. In fact juridical opinion is divided on this question, which is more complicated than appears at first sight. A further complication lies in the express reservations of the right to retaliate in kind which about one-third of the states parties (listed in table 10.1) entered when joining the treaty. A semblance of legitimacy therefore exists for possessing weapons whose use is illegal, if only because the implicit threat of their retaliatory use may be held to lend strength to the Protocol. Now that deterrence theories have become so embedded in military strategy and popular consciousness, this legitimation has seemed increasingly valid. Even so, the entry into customary international law of the Protocol's proscriptions can scarcely have left their contractual character unaffected; and the legitimation is further weakened by the fact that so few of the states that have reserved the retaliatory-use option actually maintain stocks of the weapons. Possession of biological weapons has been illegal since 1975 under the terms of the 1972 Biological and Toxin Weapons Convention, which outlaws the development, production, stockpiling and international transfer of these weapons. There has been much discussion of the negotiation history, content and significance of the 1972 Convention [4b, 8a] and of the text of the treaty [8b, 9a, 10a, 11a, 12a, 13a, 14–18].

It is both in the apparent legitimacy of possessing chemical weapons and in the absence of any sort of international verification machinery responsive to allegations of their use that the principal weakness of the present CBW arms control regime is to be found. Two other weaknesses must be noted. One lies in the consultation provisions of the 1972 Convention, whose inadequacies were clearly demonstrated during 1980–81, as described below. The other lies in various uncertainties about the precise scope of the customary prohibition on use of chemical weapons. The most important of these has followed from the position adopted by a few states that the Geneva Protocol, and hence (it is argued) the customary ban, does not cover the use of tear gases and herbicides. These positions were taken because, at the time, they satisfied certain political expediencies, not because they follow from any strict reading of the Protocol [2a, 3, 4c, 19]. This situation is dangerous, not because tear gases or herbicides in themselves present any abnormal threat to international security, but because no unambiguous distinction can be drawn between these agents and the other "poisonous ... materials" specified in the Protocol: their legitimation therefore risks impugning the entire body of law that stems from the Protocol. The UN General Assembly voted on the matter in 1969 [20], coming out in favour of an extensive interpretation of the ban by 80 votes to 3. There were, however, 36 abstentions and 7 absentees, the abstainers including most of the allies of the United States, which was at that time using tear gases and herbicides in Viet Nam. Since then other states appear to have followed the US example in other wars.

Over the past 10 years, efforts to strengthen the CBW arms control regime have been pursued very actively, mainly within the Committee on Disarmament (CD) in Geneva, its antecedent body, the CCD, and, during 1977–80, in a bilateral US–Soviet working group. Maintaining the pressure have been various international non-governmental organizations such as the Pugwash Chemical Warfare Study Group, within which many of the people associated with the CD/CCD efforts participate as private individuals. The principal remedy sought has been that of comprehensive chemical disarmament: an extension of the regime established by the 1972 Biological Weapons Convention, under article IX of which states-parties have committed themselves to "continue negotiations in good faith" on chemical weapons. The prospects for a successful outcome of these negotiations have fluctuated over the years, the present situation of resurgent Cold War giving little cause for optimism. Less ambitious remedies are, accordingly, also being sought, particularly confidence-building measures of various types.

III. Threats to the CBW arms control regime

CBW does not lie within the mainstream of military theory and practice. It is held on the periphery by international law, by domestic political constraint, by military constraint and by technological constraint, each drawing strength from the others. The problems that CBW presents for security are likewise peripheral, and for disarmament strategy as well, but the constraints cannot be seen as permanent. Changes in attitude or technology may change their strength, in one direction or the other. If the constraints were to weaken significantly over the years ahead, CBW then becoming more closely assimilated into the mainstream, the characteristics which led the United Nations in the late 1940s to class some types of CB weapon with nuclear armament as "weapons of mass destruction" could then come to exert an increasingly direct influence on security and disarmament strategies. The strain on the CBW arms control regime would then intensify. This process now seems to be in motion.

Many different factors that could promote assimilation of CBW into mainstream military theory and practice may be identified [21a, 22, 23]. Those now operating are described under five subheadings below.

Underlying the analysis is a particular theory about how states arm themselves. Its essence is this. The level of armament of a state at a particular moment, whether in quantitative or qualitative terms, is set by subsidiary processes of supply and demand. On the one side there is the pull of military demand: the process whereby military requirements perceived by the armed services and specified in terms of national security stimulate national programmes for acquiring, maintaining and deploying weapons. On the other side there is a 'push' process, stemming from the capacities of the defence industries and associated research, development and other institutions of the country to supply armaments. In principle, supply should be the same as demand. In practice, this is rarely so, given the political and organizational complexities of acquiring advanced technology. There will, moreover, exist a variety of functional linkages between the processes with the result, especially in peace-time, that demand may be at least as much a reflection of supply as the other way around. This is one explanation of why states often appear to arm themselves to a level greater than their security needs seem to warrant.

Pursuing this concept further, it becomes possible to distinguish between supply-led and demand-led forms of armament. Weapons that are poorly assimilated but nonetheless stockpiled are examples of supply-led armament. It is in the process of reconciling demand with supply—of additional requirements for the weapons becoming perceived and then endorsed at the appropriate level of decision—that the assimilation of such weapons may receive new impetus. Three such potential generators of demand in the case of CB weapons are described below: new perceptions of military utility; allegations of use; and the negotiations on chemical disarmament. These descriptions are preceded and succeeded by accounts of two supply-side factors: the existing stockpiles; and the emergent availability of new CB weapon technology.

The pressure of armament

At the time of World War II, more than a dozen states possessed stocks of the latest chemical weapons. Key scientific discoveries were being made in several countries which indicated the feasibility of biological weapons that could serve not only as clandestine special-purpose devices for sabotage and the like (a possibility that had been available, and sometimes exploited, for many centuries previously) but as mass-destruction weapons capable of striking over enormous areas. Thirty years later, the number of states publicly known to possess militarily significant supplies of modern chemical weapons had dwindled to three (France, the USA and the USSR); and biological weapons had been forsworn by international treaty. Protective measures against CBW attack are, however, actively maintained by the armed forces of all industrialized states; and in a few countries these measures have been extended, in rudimentary form, to the civilian population as well.

Except under circumstances of radical disarmament, such as during the aftermath of World War II, military capabilities of any type have a tendency to perpetuate themselves within the force structures of their possessors; new logics are generated to justify them when previous logics have become outmoded by the passage of events. It is to the existing stockpiles of chemical weapons, then, that we shall look first; later, we shall review indications of their horizontal proliferation. It is quite conceivable, of course, that more states possess chemical weapons than are publicly known to do so. Much secrecy exists in the CBW area, and for the known chemical-weapon states particulars of the levels of stocks are also largely obscured by secrecy. This is illustrated in table 10.2 which summarizes statements made by officials of the USA and the USSR about their own and the other's stocks.

Table 10.2. Reported sizes of the US and Soviet stocks of chemical-warfare agents

	US stocks (tons)	Soviet stocks (tons)
According to American sources	42 000[a]	"Estimates range from 30 000 to several hundred thousand"[b]
According to Soviet sources	300 000[c]	0[d]

[a] Lt-Col. G. Eifried (US Army Chemical Corps) in *Army*, December 1979, p. 25. He was presumably not including whatever holdings the United States may have of tear gases and herbicides. Note that a US journalist has recently quoted "informed sources" to the effect that this figure is too high and that 28 000 tons is more accurate: Wayne Biddle, 'Restocking the chemical arsenal', *New York Times Magazine*, 24 May 1981, pp. 32–49. Colonel Eifreid quotes a figure of "approximately 350 000 tons" for the Soviet agent stockpile.
[b] Dr H. Brown, during testimony before the US Senate Armed Services Committee when Secretary of Defense; see *Congressional Record*, 16 September 1980, p. S12645. He was referring to upper-level estimates that had been made by different US governmental agencies.
[c] Tass news agency, in a dispatch reported in *The Times* (London), 14 September 1981, p. 4.
[d] Tass news agency, in an English-language radio broadcast from Moscow on 3 April 1980 at 1908 hrs GMT. But see the contradictory statement by V. Gardov in *Novoye Vremya* (Moscow), No. 44 (27 October 1978), p. 14.

Chemical weapons of the United States

Table 10.2 indicates a current US stockpile of 42 000 (short) tons (38 000 tonnes) of poison gas.[1] About half is mustard gas, in three varieties (H: Levinstein mustard; HD: distilled mustard; and HT: a 60/40 mixture of mustard and the vesicant agent T), some of it residual stock from World War II, but most of it, probably, the output of the mustard programme of 1952–59 to which little public reference has been made [24]. The other half is nerve gas, in two varieties: sarin, otherwise known as agent GB, produced during 1952–57, and agent VX, produced during 1961–67 in about one-third of the quantity of sarin. There are also about 50 tons of the casualty incapacitant agent BZ, produced during 1963–64; but this agent was declared obsolete during the mid-1970s, and its stocks now await destruction.

None of these agents deteriorates significantly in storage. (The nature and properties of chemical warfare agents are described elsewhere [1, 2].) They are as potent now as they were when they were made. Most of the mustard is held in 1-ton bulk storage containers. Of the nerve gas, some 80 per cent is stored in filled munitions. In contrast to the chemical agents themselves, some of the filled munitions have deteriorated over the years to the point of unserviceability. And some are now obsolete in the sense

[1] The term 'poison gas' is used here to denote chemical warfare agents of the casualty-producing anti-personnel type, as opposed to, for example, anti-plant agents or such other anti-personnel agents as the irritants used for harassment or, in the civil context, the 'tear gases' of police armament.

that the weapon systems for which they were designed have since been phased out of US service. About 730 000 munitions are in this deteriorated/obsolete category and are currently scheduled for destruction [25]. The total number of poison-gas munitions in the stockpile exceeds 3 000 000 rounds, according to a report based on US Army data and quoted by Congressional sources [26]. Particulars are given in table 10.3. However, of the undeteriorated/non-obsolete portion of this total supply, a part is obsolescent in the sense that its delivery systems are about to be, or are actually beginning to be, phased out. If the rounds for these obsolescent weapons (notably the 105-mm howitzers and the 4.2-inch mortar) as well as those for the obsolete weapons (the 155-mm field gun and the 115-mm multiple rocket launcher) are subtracted from the three-million-round total, the remaining supply of serviceable and ready-to-use poison-gas munitions probably amounts to about 70 000 tons. Filling the

Table 10.3. Items in the US poison-gas stockpile

		Estimated quantity	
Stockpiled items Type	Agent fill	Number	Agent fill as percentage of total agent stockpile
Mustard-gas items			
Mortar cartridge, 4.2-inch	H, HD, HT	110 000	1
Howitzer cartridge, 105-mm	HD	510 000	2
Howitzer projectile, 155-mm	H, HD(?)	70 000	1
Gun projectile, 155-mm	HD	140 000	2
Bulk storage container, 1-ton	H, HD, HT(?)	16 000	44
BZ-incapacitant items			
Aircraft cluster munition, 175-lb	BZ	1 500 (both 175-lb and 750-lb)	
Aircraft cluster munition, 750-lb	BZ		<1 (all BZ items)
Bulk storage container	BZ	?	
Nerve-gas items			
Howitzer cartridge, 105-mm	GB	840 000	4
Howitzer projectile, 155-mm	GB, VX	750 000	7
Gun projectile, 155-mm	GB	290 000	3
Howitzer projectile, 8-inch	GB, VX	180 000	4
Rocket, multiple launch, 115-mm	GB, VX	400 000	6
Landmine, 2-gallon	VX	200 000	3
Aircraft bomb (exploding type), 500-lb	GB	6 000	1
Aircraft bomb (splash type), 500-lb	GB	888	<1
Aircraft bomb (exploding type), 750-lb	GB	18 000	6
Aircraft spraytank, 160-gallon	VX	1 500	3
Bulk storage container, 1-ton	GB, VX	5 200	12

Source: US Defense Department data referenced in Perry Robinson, J.P., 'American chemical-warfare capabilities: collated data and estimates' (unpublished). Note that most of the figures given in the 'Estimated quantity' columns are extremely crude estimates for which no direct confirmation is available in open official US sources.

Table 10.4. US poison-gas storage locations and related facilities

Facility, location	Chemical-warfare functions	Estimated holding of poison gas as a percentage of total stocks, and other particulars	
Tooele Army Depot, Tooele, Utah	Agent/munition storage; pilot chemdemil (CAMDS)	40–45	Nerve (GB & VX) and mustard (H, HT & HD) gases, both bulk and weaponized; no USN munitions, only Army & USAF
Pine Bluff Arsenal, Pine Bluff, Arkansas	Agent/munition storage; projected binary production	10–15	Nerve, mustard and BZ; at least part of the nerve gas is in munitions; at least part of the mustard is in bulk; of the ca 50 tons of BZ about 20 per cent is in bulk; army munitions only
Umatilla Army Depot Activity, Hermiston, Oregon	Agent/munition storage	10–15	Nerve and mustard gas; at least part of the mustard is bulk HD; at least part of the nerve gas is weaponized GB; Army, USN & USAF munitions
Anniston Army Depot, Anniston, Alabama	Agent/munition storage	ca 10	Nerve & mustard; at least part of the nerve gas is weaponized GB & VX; at least part of the mustard is bulk HD and weaponized HD & HT
Pueblo Army Depot Activity, Pueblo, Colorado	Agent/munition storage, as an outstation of Tooele Army Depot	ca 5	Mustard only, no nerve gas; probably all weaponized; unfilled as well as filled munitions; no USN or USAF munitions
Aberdeen Proving Ground, Edgewood/Aberdeen, Maryland	R&D (with test sites), including pilot agent-production and munition-filling plant; agent/munition storage; CW training[a]	ca 5	Mustard but no nerve gas, at least part being bulk HD; also, one of the 3 main storage sites for agent DM; about 15 tons, awaiting disposal
Newport Army Ammunition Plant, Newport, Indiana	Standby agent (VX) production and munition-filling; agent/munition storage	ca 5	VX nerve gas only, probably at least part in bulk; no USN or USAF munitions
Johnston Island, Pacific Ocean	Agent/munition storage; chemdemil facility under construction	ca 5	Nerve and mustard, probably all weaponized: 2 057 tons of VX items, 8 322 tons GB items, 2 865 tons mustard items; Army, USN and USAF
Fischbach, near Pirmasens,[b] FR Germany	Agent/munition storage	2–5	Nerve gas only (GB & VX), probably all weaponized; probably less than 10 000 tons of munitions

Lexington Blue Grass Army Depot Activity, Richmond, Kentucky	Agent/munition storage, as an outstation of Red River Army Depot, Texarkana, Texas	1–2	Nerve gas; apparently no mustard; at least part of the nerve gas, probably all, is weaponized; no USN or USAF munitions
Rocky Mountain Arsenal, Denver, Colorado	Standby agent (GB) production and munition-filling; agent/munition storage; chemdemil	negl	Only about 1 000 tons phosgene, awaiting disposal, now remains at this once major storage location
Dugway Proving Ground, Dugway, Utah	Test site	negl	RDT&E quantities only: probably quite large and varied
Redstone Arsenal, Huntsville, Alabama	CW training[a]; WWII production site	negl	RDT&E quantities only: presumably demonstration quantities
Phosphate Developments Works, Muscle Shoals, Alabama	Standby production facility for GB-precursor (dichlor)	0	None

Conventions: CAMDS—chemical agent/munition disposal system; chemdemil—detoxification/demilitarization of chemical agents/munitions; R&D—research and development; RDT&E—research, development, test and evaluation; CW—chemical warfare; USN—US Navy; USAF—US Air Force; WWII—World War II; negl—negligible.

[a] The CW instruction at Aberdeen and Huntsville is provided within the co-located US Army Ordnance & Chemical Center and School and the US Army Missile & Munitions Training Center and School, respectively. A third CW school was opened in 1979 at Fort McClellan, Alabama; this site had been the location of the original US Army Chemical Corps training centre, which had been closed in 1973, its training mission being transferred to the Ordnance School at Aberdeen.

[b] According to Defense Department testimony to the Congress, there are only two storage sites for US chemical agents/munitions outside the continental United States, one on Johnston Island and the other in FR Germany at an unspecified location. West German journalists have identified Fischbach as the site in FR Germany (see text).

Source: US Defense Department data referred to in Perry Robinson, J.P., 'American chemical-warfare capabilities: collated data and estimates' (unpublished).

bulk-stored mustard and nerve gases into munitions could provide up to about 200 000 tons more.

More than 90 per cent of the total US supply of poison gas is held within the United States. Only two overseas stockpiles have been referred to in public statements by US officials. One is on Johnston Island in the Pacific, whither stocks formerly held in Okinawa were removed in 1971. The other is at a single location in West Germany, presumably one of the 33 ammunition supply points which, together with its two central ammunition depots, the US Army maintains in the Federal Republic, each of which holds between 6 000 and 10 000 tons of ammunition [27]. According to a recent West German television documentary [28], the site is at Fischbach, near Pirmasens. This supply has not been assigned to NATO and remains totally under US control. Further particulars of the US poison-gas supply are given in table 10.4.

There has been no large-scale production of poison gas in the United States since 1967 or of filled poison-gas munitions since 1969, when President Nixon ordered immediate curtailment pending development of 'binary' nerve-gas munitions. The first of these munitions became ready for production in 1977, since when pressure has been mounting to mass-produce them as part of what is portrayed as a necessary 'modernization' programme.

A digression into theory: generally applicable lessons from the US experience. It is in drives towards modernization such as the foregoing that the pressure of armament on the existing CBW arms control regime is most evident. A brief digression to explain this more fully is in order here, for the lessons that may be learnt seem to have a general relevance that goes beyond the particular case of the United States. It is only due to the abnormal openness in CBW matters on the part of the United States that any such discussion—or, indeed, much of the description that has just been given—is possible.

US armed services have had no actual experience of using poison gas in war for 64 years now. For the United States, then, notions of what the latest types of poison-gas weapon can do, how many of them are needed to do it, and how they relate to other weapons, are now entirely theoretical: inferences from history, from field experiments and from computer simulations that can reflect the likely realities of future combat only dimly. These are the notions, however, from which the formal military requirements for poison gas are stated. For methodological reasons alone, therefore, the demand for chemical weapons by US armed forces has been, and will remain, an uncertain one, fluctuating widely over both time and between the different combat branches. During 1980 this matter was under the detailed scrutiny of an interdepartmental group co-ordinated by the

National Security Council. The review was curtailed at the change of Administration without consensus having developed around any of the widely differing estimates submitted by the participating agencies as to what the level of US stocks of poison-gas munitions ought to be. At one end of the scale were the estimates of the Joint Chiefs of Staff, which posited a minimum requirement for nerve gas munitions that was some four times greater than the supply of serviceable and ready-to-use nerve-gas munitions then on hand [29, 30]. At the other end of the scale was another agency's estimate which suggested that the current stockpile overfulfilled the real requirement. It now seems that under the Reagan Administration a consensus has been reached on a figure exceeding the current supply.

That is something of the picture on the demand side of the US chemical armament process. On the supply side, development and production of chemical munitions were the responsibility, until the early 1960s, of the Army Chemical Corps acting for all the services. With the reorganization of the Army in 1962, the Chemical Corps lost much of its previous autonomy. Its supply missions passed to the Army Materiel Command and then to the latter's successors, where, however, they still remained the responsibility of Chemical Corps personnel assigned to those agencies. The Corps itself (or rather its antecedent, the Chemical Warfare Service) had been established by federal legislation in 1920, which subsequently served to protect it over the years against recurrent vicissitudes both within the national military establishment and outside it. In 1973 the Defense Department commenced action to repeal the legislation, but soon abandoned the attempt. These matters are noted here to convey something of the institutional strength that lies behind the supply of chemical weapons in the United States. It is a strength, moreover, which readily becomes transformed into positive pressure for continuing supply by virtue of mechanisms that are inherent to any large bureaucracy. With chemical warfare way outside the mainstream of military practice, the tendency within the US defence bureaucracy has long been, in effect, to refer decisions that have to be based on notions of the utility of poison gas to the few people who have mastered the requisite theory. It is the Joint Chiefs of Staff who, at intervals, issue the guidance to the military commands on what the latter's stocks of poison gas ought to be; but the initial, and very probably the only, draft of that guidance will have come from the Chemical Corps, whose institutional imperatives it will therefore reflect.

US poison-gas munitions can thus be seen as an example of supply-led armament. Manufactured by the million, few of them have actually been moved anywhere near the places where, according to the utilities ascribed to them, a positive demand ought actually to exist. Some of them (such as the 1 000-pound sarin cluster-bombs or the big sarin warheads for Honest

John rockets) spent their entire lives at the Chemical Corps arsenal where they were manufactured and where, having become obsolete, they were destroyed.

Not surprisingly, therefore, the Reagan Administration can now be observed postponing decision about where to deploy the new binary nerve-gas munitions until after its decision on whether or not to produce them [25]. As in the parallel and, in this respect, identical case of the neutron bomb, intra-NATO political factors, expressed as host-country reluctance to provide forward-deployment facilities, can be portrayed as the reason. But is not the more fundamental reason a lesser sensitivity on the part of those potential host countries to the supply-side pressures that afflict the United States, and thus a greater freedom on their part to act on more realistic assessments of military requirements?

Chemical weapons of France

The size, nature and content of the French chemical-weapons stockpile remain largely unknown outside French military circles. It has been US officials, not French ones, who have confirmed its existence to the general public [31]. French officials have offered no refutation of this disclosure, as they could most painlessly have done after the entry of France into the chemical disarmament negotiations in Geneva in 1979, when France became an active member of the new Committee on Disarmament. The organization and administration of French chemical-warfare capabilities are only sparsely covered in open sources [2b, 32, 33].

The French Army created a Special Weapons Command in 1952, amalgamating the pre-existing 'Groupement Y', concerned with atomic weapons, and the 'Groupement Z', which had for some years been experimenting with the recently discovered nerve gases, primarily on the vast chemical-warfare test range, B2 Namous, near Beni Ounif in the Sahara; B2 Namous continued in use for such purposes even after Algerian independence, terminating in 1975. The Special Weapons Command does not, however, appear to have valued chemical weapons particularly highly, its priority task (aside from its dominant mission of developing a nuclear-weapon capability) being the creation of effective anti-chemical protection for combat units, protection which is now at an impressive level [34, 35]. Development of chemical weapons was pursued, however, but under a general chemical-warfare policy which expressly recognized that France was bound by the Geneva Protocol to refrain from using the weapons except in retaliation. There had been working contacts with the US chemical-weapon programme by 1952, which apparently continue to this day under various bilateral agreements. Instruction in chemical warfare is given at the Special Weapons School at Grenoble [36].

It is not known when actual production of nerve-gas weapons commenced. A brief review of the 15 principal establishments of the Service des Poudres, to which the task had presumably fallen, published in 1970 [37], records a maximum labour force of 1 700 workers at the Pont-de-Claix facility near Grenoble specializing in 'les armements chimiques'. This factory is not referred to in the current publicity literature of the Service's successor organization, the SNPE, though there is reference (as there was in the 1970 review) to a facility at Toulouse given over to unspecified 'produits chimiques'. It is understood that the Toulouse facility included a pilot plant for the development of nerve-gas production techniques; that this plant operated from 1965 to 1974, when it was dismantled; and that SNPE Toulouse is now developing binary nerve-gas technology. Whether binaries will come to replace the current French supply of nerve gas, which is reckoned to amount to some hundreds of tons, remains to be seen.

A press report during 1981 purported to describe how the government of Saudi Arabia had enlisted the help of the French government in using 'nerve gas' to dislodge the revolutionaries who had occupied the central Mosque in Mecca during 1979 [38]. The report refers to some tons of 'CB-gas' having been supplied for this purpose by France, quoting from official French documents. However, 'CB' is the designator used in France, not for any nerve gas (a term which denotes lethal anticholinesterase agents, usually organophosphorus ones), but for the irritant agent known in English as CS gas. The report made no mention, it may be observed, of the "new instant-knockout gas . . . which causes almost instantaneous loss of consciousness but has no harmful after-effects"[2] with which a French anti-terrorist unit was said to be armed in 1976 [40].

Chemical weapons of the Soviet Union

As in the case of France, it is mainly on US officials that the general public has to rely for information about Soviet chemical weapons. Soviet officials have made no direct public reference to the existence of such weapons since 1938 and have, indeed, on one recent occasion, denied their existence altogether (see table 10.2). Indirect reference to the weapons abounds in the Soviet literature [41a], however, and, at least in the minds of defence officials in Western and several non-aligned countries, their existence cannot seriously be doubted.

It is apparent from the September 1980 testimony of the US Secretary of Defense to the Senate quoted in table 10.2 that the West has no firm information about the size of the Soviet stockpile. Current professional

[2] Such an agent is, almost certainly, physiologically impossible, but the idea has long taken the fancy of many people. A more recent report in this vein credits West German police with an immobilizing chemical that puts people out of action for up to 30 minutes while leaving them fully conscious and unafflicted by harmful side-effects [39].

Table 10.5. Putative Soviet poison-gas weapons

	Designator, lowest-level formation to which the weapon is organic, and number organic to a Motor-Rifle division[b]				Estimated[d] maximum quantity of nerve gas deliverable by a single fire-unit of the weapon (tons per fire-unit) within		
Type of weapon[a]	Designator	Level	MR Div assets	Range[c] (km)	1 min[e]	5 min	Fire-unit assumed
Naval weapons (unspecified)	..	..	0	..	..	..	..
Landmine	KhF	..	..	0	..	..	..
Mortar, 120-mm	M-43	regiment	60	5.7	0.2	0.8	bty of 6
Howitzer, 122-mm	D-30 etc.	regiment	108	15.4	0.3	1.2	bn of 18
Multiple rocket launcher, 122-mm	BM-21 Grad	regiment[h]	18	20.5	2.9	2.9	bn of 18
Gun, 130-mm	M-46	army	0	27.2	0.4	1.5	bn of 18
Howitzer, 152-mm	D-20 etc.	division	18	17.5	0.4	1.6	bn of 18
Gun, 180-mm	S-23	front	0	30.4	0.2	0.8	18
Multiple rocket launcher, 240-mm(?)[f]	BM-27/M-1977	front	0	> 30(?)	11	11	bn of 18
Free-flight rocket, 550-mm	FROG-7B	division	4 TELs	65	0.7	0.7	bn of 4 TELs
Short-range ballistic missile, 850-mm	SS-1c Scud B	army	0	280	1.2	1.2	bn of 3 TELs
Medium-range ballistic missile, 1100-mm	SS-12 Scaleboard	front	0	930	1.4	1.4	bn of 3 TELs
Intermediate-range ballistic missile[g]	SS-20	(SRF)	0	5 000[i]	0.3[j]	0.3	1 TEL
Strike aircraft	MiG-21, Su-19 etc.	(FA)	0	400–1 600	2,3	2.3	1 Su-17

Conventions: SRF—Strategic rocket forces; FA—Frontal aviation; TEL—transporter-elevator-launcher; bty—battery; bn—battalion.

Sources: as indicated in the notes below.

[a] The weapons listed are ones which published sources state have a chemical-delivery capability. None of the sources indicate why they state this, so it is never clear whether their information is the merest speculation or based on hard data. Older weapons are not listed (among which the 240-mm heavy mortar, the self-propelled 16-tube 140-mm, 6-rail 250-mm and 6-rail 280-mm multiple rocket launchers, the 310-mm self-propelled rocket gun, the earlier FROGs and Scuds and the SS-C-1b Sepal ground-launched cruise missile have been said to have a chemical-delivery capability). Except where indicated, the sources relied upon are identified in Perry Robinson, J.P., 'Chemical warfare capabilities of the Warsaw and North Atlantic Treaty Organizations: an overview from open sources', *Chemical Weapons: Destruction and Conversion* (Taylor & Francis, London, 1980, SIPRI), pp. 30–36, or, for the older weapons, in Perry Robinson, J.P., 'Should NATO keep chemical weapons?', *SPRU Occasional Paper Series*, No. 4 (Science Policy Research Unit, University of Sussex, August 1977), Appendix A, and in *The Problem of Chemical and Biological Warfare*, Volume 2 (Almqvist & Wiksell, Stockholm, 1973, SIPRI) pp. 174–79. Chemical rounds are said to be available at scalings ranging between 3 and 30 per cent of total ammunition holdings for particular weapons, though some published sources maintain that the scaling may be as high as 50 per cent for some weapons. The principal poison-gas loadings are thought to be mustard, hydrogen cyanide and the nerve gases tabun and soman, the latter in both thickened and unthickened forms.

[b] As in the Group of Soviet Forces in Germany.

[c] For the aircraft, laden hi-lo-hi combat radius.

[d] The estimates are from Perry Robinson, J.P., 'Soviet chemical-warfare capabilities: collated data and estimates' (unpublished). Whether nerve-gas ammunition is in fact available for each of the weapons is not known. For mustard loadings, the deliverable agent tonnage could be 1.5–2 times greater; for hydrogen cyanide, which is unsuited to small munitions, it would be a good 1.5 times smaller.

[e] For analogous estimates on US chemical weapons, see Perry Robinson, J.P., 'Chemical weapons and Europe', *Survival*, Vol. 24, No. 1, January/February 1982, pp. 9–18.

[f] This recently introduced weapon is listed as a chemical-delivery means by Dick, C. J., 'Soviet chemical warfare capabilities', *International Defense Review*, Vol. 14, No. 1, 1981, pp. 31–38.

[g] According to Major C. J. Davidson ('Situation report on chemical warfare', *Journal of the Royal United Services Institute*, Vol. 125, No. 2, June 1980 pp. 63–65), the SS-20 "is reputed to have one chemical for each nuclear warhead available".

[h] The BM-21 was initially a divisional weapon, but it is now reported that its hitherto independent battalions are integrated into the artillery regiments of each Tank and Motor-Rifle division; see *International Defense Review*, Vol. 14, No. 6, 1981, p. 701.

[i] This is the range given by the IISS (in *The Military Balance 1981–1982*, p. 105) for the SS-20 Mod 1; for the Mod 3, the range quoted is 7 400 km.

[j] Derived from the figure of 1 200 pounds given for the throw-weight of the SS-20 Mod 2 by Dornan, J. E., Jr., 'The Soviet Strategic Rocket Forces' in *The Soviet War Machine*, ed. R. Bonds (Salamander, London, 1980 edition).

estimates range from less than 30 000 to more than 700 000 tons of chemical agents. A figure of 350 000 agent-tons is now becoming entrenched in the literature, acquiring an aura of credibility through frequent repetition [42a]. In fact it is no more than the arithmetic mean of the smallest and largest estimates. If stored in weapon form, 350 000 tons of poison gas would correspond to 3 000 000 tons of chemical munitions, give or take 50 per cent: a figure so enormous as to cast grave doubt on its plausibility.[3] It stands in marked contrast to a West German estimate of the USSR "having available a potential of 200 000 to 700 000 tons of theatre chemical weapons" [44]. Note that the lower end of this range could imply a Soviet *agent* stockpile only half the size of the present US one.

Possibly relevant is the fact that in Soviet military parlance the term 'chemical weapon' subsumes not only poison gas, herbicides and irritants but also incendiaries, smoke and flame munitions. Similarly the term 'chemical defence' embraces protective measures not only against chemical weapons but also against biological weapons and the various radiation effects of nuclear weapons [45].

In contrast to their quantitative information, US officials give the impression of possessing rather precise qualitative information about Soviet chemical weapons. The chemical agents said to be stockpiled include a variety of types of World War I/II vintage (chloropicrin, phosgene, diphosgene, hydrogen cyanide, adamsite and mustard) as well as nerve gases. The latter were initially thought to be limited to tabun, but since the 1960s there have been reports of soman as well, including a thickened form designated VR55 [41a]. In 1960, mustard gas was said to preponderate in the total stockpile. As for agent-dissemination means, the open literature contains references to a large variety of Soviet chemical munitions, but it is never clear whether these references originate in firm information or in speculation about the possible adaptability of a particular weapon system to chemical delivery. The references are summarized in table 10.5.

There have been reports in official Western publications of the Soviet Union having deployed stocks of chemical weapons to the German Democratic Republic (GDR), Poland and Czechoslovakia [41a]. In addition, there have been other reports of Soviet stocks in Cuba [46, 47], Ethiopia [48], Iraq [49–52], Laos [46], Viet Nam [46] and, by implication, Afghanistan [46]. On the information publicly available, it is impossible to judge how much, if any, credence may be attached to these reports. Of the stocks held inside the Soviet Union, some are reported to be deployed along the Chinese border [53].

For the past several years there have been innumerable reports in the non-specialist literature that the USSR has been expanding its stocks of

[3] Note that the entire US 'wholesale' inventory of all types of munition, conventional as well as chemical, is around two million tons [43].

chemical weapons, and that it still continues to do so. Statements by senior Western officials also refer to a build-up; but what they have invariably been referring to has been an increase in offensive chemical-warfare capability, not continuing production of chemical weapons [54, 55]. They mean by this the continuing build-up of anti-chemical protection that had commenced during the 1960s [45, 56] coupled with the increased deployments of weapon-systems capable of firing, among other things, chemical ammunition. That the additional weapons (such as the battalion of 122-mm howitzers now being received by Soviet tank regiments in the GDR) *could* be used to spread more nerve gas than had hitherto been possible is true; that the increased anti-chemical protection *could* provide Soviet forces with greater shielding against the collateral effects of their own chemical weapons is also true, but whether they are actually *intended* for these purposes is another matter. As for continuing production of chemical agents or munitions, it is reliably reported that the US intelligence community has no hard evidence of any such production during the 12 years that have now elapsed since cessation of US production [57].

Nor, it must be said, does the United States appear to have any hard evidence that the USSR has not been producing chemical weapons these past 12 years. If institutional pressure for 'modernization' of stocks has indeed been as strong for the United States as has been suggested above, the possibility of a similar supply-side influence on the USSR must also be admitted, for there too a largely autonomous Chemical Service has long been in existence [58].

Horizontal proliferation of chemical weapons

With regard to the possibility of poison-gas weapons spreading beyond the United States, France and the Soviet Union, there would seem to be three main types of promoter.

The first, now becoming apparent in Europe, may be seen as a lateral extension of vertical proliferation in which the chemical-weapon capabilities of one or another of the three possessor states are opened to military allies. An important pressure here is that of force integration: alliances seeking to ensure that there are no great disparities in military capability across the forces of member states defending a common front. Within NATO, the United States has long been advocating a more coherent alliance policy on chemical-weapon employment [59], a necessary component of which would, in the US view [60], be a more integrated retaliatory capability. However, there are no firm indications yet that any of the NATO states are willing even to accept more US chemical weapons into forward deployment, still less that any of them are re-acquiring chemical weapons of their own. During 1980 there were signs that Britain might have been moving in one or both of these directions [61, 62], but in the following year the British government announced that it had no plans for acquiring chemical weapons [63–65], and would thus continue with the policy of CW non-armament that had been followed by its six predecessors. Once US production of binaries gets under way (see below), pressure on the West Europeans from across the Atlantic can again be expected to intensify. In the meantime NATO as a whole is strengthening its anti-chemical protective stance [41a, 66–68] and also, it may be noted, increasing its deployment of weapons capable of delivering chemical agents. As regards the WTO, US officials have stated that an additional member state is acquiring an indigenous production capability for chemical warfare agents [69]; they were apparently referring to Czechoslovakia.

The second promoter lies in the notion of CBW weapons as the 'poor man's deterrent', which was quite common some twenty years ago among Western arms control theorists. However, in those regions of the world to which proponents of the notion deem it applicable, only in those particular ones in which the proliferation of nuclear weapons has seemed imminent has there been, in recent years, much serious overt talk of CBW armament. The case of Egypt is illustrative. In the US press there have been reports [70, 71] of Egyptian leaders considering building up a nerve-gas capability to deter Israel from using its putative nuclear weapons. Concerns have been expressed more than once about just such an eventuality by senior Egyptian scientists at international conferences [72]. In the idea of more easily accessible weapons of mass destruction countervailing or substituting for nuclear armament, there may thus be a motor of proliferation, but there are few signs yet that it is running. It is worth noting here that, contrary to press reports at the time, which continue to be quoted today [46], Israeli forces encountered no stocks of Egyptian poison gas during either the 1967 or the 1973 Arab–Israeli wars. With regard to other regions there has been recent reference to Pakistan, like Viet Nam, appearing to have chemical weapons [73]; and there is a report of a South African 'chemical weapon plant' nearing completion, as of 1978, in the Orange Free State [74]; but these reports remain unconfirmed.

Finally, incentives may lie in the undoubted propensity of chemical weapons for exerting major military impact upon adversary forces lacking anti-chemical protection, and for terrorizing or otherwise coercing civilian populations. All of the authentic instances of chemical weapons employment since World War I have exploited these properties: by Spain in Morocco in 1925 [1a, 75–77]; by the USSR in 1934, during its incursion into Sinkiang in support of a friendly regime beleaguered by Tungan mujahideen [1a, 78]; by Italy in Ethiopia during 1935–36 [1c, 79–81], by Japan in China during 1937–42 [1d, 82]; and by Egypt in the Yemen during 1963–67 [1e, 46, 5b]. Also within this pattern are the chemical herbicides used by Britain in Malaya during the early 1950s [1f, 83]; by France in North Africa during the late 1950s; by the United States in Indochina, together with irritant agents, during 1961–70 [1g, 84]; by Portugal in its insurgent African colonies from 1968 into the mid-1970s [1h, 85]; and now, it is alleged, by Ethiopia in Eritrea [48, 86, 87]. It is largely because some of the more recent allegations of poison-gas warfare, noted below, fit so squarely into this historical tradition that they have acquired credence.

New perceptions of military utility

The value of chemical weapons as a deterrent of CBW is the only justification that can be given in public for possessing such weapons. In the West, the idea of poison gas deterring poison gas has for several decades accommodated both supply-side pressure and reluctance on the part of military leaderships to take CBW seriously. This is now changing, due mainly to the growth of nuclear armament, to new perceptions in the West of military threat, and to their consequence—the current ascendancy of deterrence doctrines in which deterrence is held to reside, not in uncertainties about the likelihood of nuclear retaliation, but in the relative certainties of war-fighting capability. With chemical weapons thus receiving wider attention as instruments of war fighting, so too is their utility in roles other than deterrence.

People still point to the abstention from chemical warfare during World War II, when all the main belligerents had poison-gas supplies, as evidence of in-kind chemical deterrence working. But in fact the main retaliatory threat both posed and perceived then was of population-killing chemical air raids on cities: a threat whose credibility has long since been destroyed by nuclear weapons. There is no historical evidence of the deterrence working at less escalatory levels of threatened retaliation.

Nuclear weapons serve as the basis for the general deterrent with which their possessors seek to discourage adversaries from resorting to war. To believe that a specific intra-war deterrent is also needed is tantamount to believing that without it the general deterrent would be ineffective. In the case of chemical weapons, at least three pre-conditions must be satisfied before such a belief is tenable. One is that opposing nuclear forces have deterred themselves out of all practical relevance to actual war-fighting: that is, an aggressor could feel confident that his resort to poison gas in conventional fighting carried a negligible risk of inciting nuclear retaliation. The second is that of poison gas having such great tactical utility that only by using it to enhance the effectiveness of his conventional forces could the aggressor be confident of achieving his war aims. The third is that retaliatory use of poison gas could offer such an increase in the effectiveness of the defending forces as to discourage the aggressor from resorting to it in the first place.

The plausibility of the second and third of these pre-conditions depends on the efficacy of anti-chemical protection. The US Defense Department believes that its forces in Europe, which are not as well protected as some of the other NATO forces [88], are capable of surviving surprise chemical attack [25]. Soviet forces in Europe are thought to be less capable of surviving surprise attack but more capable of withstanding anticipated or repeated chemical attacks [45]. As far as retaliatory value to the West of chemical weapons is concerned, the second and third pre-conditions would not appear to apply. However, the question then arises as to what the impact on combat performances might be, not of poison gas, but of the anti-chemical protective measures themselves. Could the encumberment and time-delays that they impose so degrade fighting efficiency or the tempo of operations as to generate a significantly asymmetric disadvantage, and thus revalidate the notion of in-kind chemical deterrence? Protagonists of Western chemical rearmament say yes [25, 89–96]; others doubt it [97–100].

Such as it is, the case for retaliatory chemical capability as an essential component of the general deterrent reduces itself to detailed consideration of postural differences between the forces of the initiator and the retaliator, and to the capacity of the latter for exploiting those differences to a significant extent. The opportunities for such exploitation would be strongly contingent upon the precise course of battlefield events. There is thus a fourth pre-condition: that the retaliatory capability be so closely integrated into the forces and doctrines of its possessor that it can be used without significant delay, before such opportunities pass. For a weapon whose use is illegal, this is a most difficult requirement for any armed force to fulfil, for the lower the expectation of a particular weapon being used, the lower will be the incentive acting on the relevant training, doctrine-development and logistics commands to assimilate the weapon—to give it the requisite priority over other pressing tasks. A contradiction is thus generated: unintegrated, the weapon may not deter, in which case the expectation of non-use that impedes integration may prove unjustified; but, integrated, it may deter, thereby justifying the expectation.

An inevitable product of this contradiction is pressure against the no-first-use policy which sustains it. There is historical precedent. When, in the 1950s, the United States abandoned the no-first-use policy on chemical weapons that had been in force since 1943,[4] it did so because there seemed to be no other way of ensuring that its programme for

[4] The policy in force during 1956–69 was use-at-President's discretion. The no-first-use policy was formally reinstated by President Nixon at the time of his decision to re-submit the Geneva Protocol to the Senate for ratification advice and consent.

acquiring an effective nerve-gas capability could be kept up to schedule [22]. And once the no-first-use policy has gone, a possessor of chemical weapons is bound to look beyond deterrence for additional utility; as indeed happened during the Viet Nam War.

Can we be confident that the international law establishing the present chemical arms control regime is capable of withstanding such pressure? If it is, then the only other logical way out of the contradiction is chemical disarmament. The fact that the negotiations to this end have proceeded as far as they have done is testimony, perhaps, to the strength of the regime. The decisive factor will presumably be the military attractiveness of whatever utilities there are beyond deterrence. That such utility exists is, of course, inherent in the belief that a chemical deterrent is needed at all. The US Defense Department is firm on this point: rightly or wrongly it believes that Soviet "doctrine clearly envisions the use of chemical weapons when they believe a significant tactical advantage can be gained . . . a policy on use which does not reflect treaty commitments or obligations" [25].

We thus arrive at the nub of the whole issue, manifest as deteriorating confidence. There is little to differentiate a retaliatory chemical capability from an initiatory one. Ascendant opinion in the West now believes that Soviet chemical weapons exist to satisfy other requirements than merely deterring the Americans and French from using their poison gas: requirements that could have been generated from Soviet scenarios of war in Europe or against China or in the developing world. Whether this perception is an artefact of US supply-side pressure or soundly based on the best available intelligence on Soviet chemical-warfare programmes has become immaterial, for it is now embedded within the wider perception of a Soviet Union that is driving for military superiority in all fields. Soviet commentary dismisses this image of the USSR as "mythical" [101], portraying its propagation as deliberate misinformation aimed at securing increased appropriations, in this case for the US nerve-gas programme [102], a programme which is itself portrayed in the commentary as evidence of US insincerity in negotiating chemical disarmament [103]; for these and other such reasons, "the men of the Soviet Armed Forces are obliged to display high vigilance and should be ready to defeat any provocations of imperialism" [104].

Allegations of infraction

Reinforcing the foregoing Western perceptions are reports of Soviet client states, and Soviet forces as well, actually using chemical weapons in conflicts in Asia and Africa. Such reports began to receive international press coverage towards the end of 1978, and by November 1981 those that

Table 10.6. Alleged instances of poison-gas and germ warfare since 1974

Alleged user, and occasion	Period	Weapons allegedly used	Documentation[a]
Laotian and Vietnamese forces in Laos	1974–1981	Mustard gas, irritants, nerve gas and mycotoxins spread by aircraft	See text
Both sides during the Shaba rebellion in Zaire	May 1977	Poison arrows	(1)
South African forces during air attack on Kassinga, Angola	May 1978	"Paralyzing gas"	(2)
Vietnamese forces in Kampuchea	1978–1981	Irritants, cyanide, tabun and mycotoxins spread by aircraft or artillery; poisoning of water	See text
US covert action (CIA) in Cuba	1978–1981	Causing sugar-cane rust, blue mould of tobacco, African swine fever and, in people, haemorrhagic dengue and haemorrhagic conjunctivitis	(3) On US government denial: (4)
Vietnamese forces against Chinese invasion	February 1979	"Poison gas"	(5)
Chinese forces in Viet Nam	February 1979	"Toxic gas" and "poisoning of drinking water sources"	(6)
Soviet forces in Afghanistan	1979–1981	Nerve gas, irritants, "Blue-X" incapacitant and mycotoxins spread by aircraft and ground weapons; toxic bullets	See text
Mujahideen in Afghanistan	1980–1981	"Lethal chemical grenades"	(7) On US government denial: (8)
Ethiopian forces against Eritrean secessionists and in the conflict with Somalia	Summer 1980	"Chemical warfare" (allegations coincide with reports of nerve-gas supplies reaching Asmara and Massawa)	On use: (9) On shipments: (10) On Ethiopian government denial: (11)
	April 1981	"Chemical spraying"	(12)
Iraqi forces in Iran	November 1980	"Chemical bombs"	(13)
Salvadoran Army and National Guard in El Salvador	1981	"Toxic gas", "chemical bombs" and "acid spray"	(14)

[a] The literature references are as follows:

(1) Reuter dispatch from Kinshasa, 8 May 1977, quoting Zaire Radio and Zaire government sources, as in *The Times*, 9 May 1977.

(2) 'Report on the Cassinga attack prepared by a joint UNHCR/WHO mission on 30 May 1978' (Luanda, 1 June 1978); reproduced as Annex V in UN document S/13473 of 27 July 1979.

(3) President Castro in a speech on 26 July 1981 (relevant part of text in Committee on Disarmament doc CD/211 of 13 August 1981); Cuban government declaration published in *Granma*, 9 September 1981 (see *The Times*, 10 September 1981); Cuban Foreign Minister in a speech to the UN General Assembly on 24 September 1981 (see *The Times*, 26 September 1981, p. 3).

(4) For example, US Ambassador Flowerree at the Committee on Disarmament, 18 August 1981 (see CD/PV.147, pp. 41–2).

(5) Kyodo dispatch from Beijing, 20 February 1979, as in English-language radio broadcast from Tokyo on same day at 1239 hrs GMT (transcript in Sterling Seagrave, *Yellow Rain* (Evans, New York, 1981), pp. 218–9); Congressman Jim Leach in testimony before a House Foreign Affairs Subcommittee on 12 December 1979 during a hearing published as *Use of Chemical Agents in Southeast Asia since the Vietnam War* (see p. 11).

(6) 'More lies about Vietnam', *Soviet News*, no. 1959 (25 August 1979), p. 6; 'Letter dated 22 January 1980 from the Chargé d'Affaires a.i. of the Permanent Mission of Viet Nam to the United Nations addressed to the Secretary-General', UN doc A/35/71 of 23 January 1980.

(7) 'Declaration of the Government of the Democratic Republic of Afghanistan issued 11 April 1980', in Committee on Disarmament doc CD/89 of 14 April 1980; V. Vashedchenko, 'Chemical weapons race', Tass article of 11 September 1980 (in *APN Daily Review*, Vol. 26, No. 181, 12 September 1981, p. 6); 'Washington's 'chemical weapons' farce', *Soviet Weekly*, 26 September 1981.

(8) US Ambassador Flowerree at the Committee on Disarmament, 22 April 1980 (see CD/PV.80, pp. 37–9).

(9) M. Getler, 'US cites evidence of use of chemical weapons', *Washington Post*, 8 August 1980, p. 18; speech by US Senator Heflin, in *Congressional Record*, 16 September 1980, p. S12638.

(10) Ermias Debassai, 'Urgent appeal to all peace-loving Governments, Political Parties and Humanitarian Organizations' (Eritrean Peoples Liberation Front Rome office, 30 May 1980) and associated newspaper reports (e.g. *Sunday Times*, 8 June 1980, p. 9; *Boston Globe*, 11 June 1980, p. 3; *The Guardian*, 19 June 1980, p. 8; *The Times*, 27 June 1980, p. 9); Reuter dispatch from Port Sudan, 4 August 1980, as in 'Eritrean rebels said to expect gas attack', *International Herald Tribune*, 5 August 1980; D. Connell, 'A lesson of hope from Eritrea', *New Statesman*, 7 November 1980, pp. 20–1.

(11) Sir Ian Gilmour (for the UK Foreign Office), written answer to Parliamentary question, *Hansard (Commons)*, 6 November 1980, col. *629*.

(12) ''3000 hit in Ethiopia' claim rebels', Associated Press, as in *Daily Telegraph*, 28 April 1981, p. 5.

(13) Teheran Radio quoted in Tony Allen-Mills, '500 die in Iraqi onslaught', *Daily Telegraph*, 17 November 1980, pp. 1 & 30, and in UPI dispatch from Baghdad, 18 November 1980.

(14) A report issued by the Commission for the Defense of Human Rights in Central America, 11 August 1981, quoted in *New York Times*, 13 August 1981, p. A5; Tass dispatch from Moscow, 14 September 1981, quoted in *Washington Post*, 15 September 1981, p. 16, and in *New York Times*, 15 September 1981, p. 8.

related to Laos, Kampuchea and Afghanistan had been publicly endorsed by the US government [105]. Both chemical and toxin agents were implicated, thus suggesting violation not only of the customary-law use-prohibition but also of the 1972 Biological and Toxin Weapons Convention as well [106]. However, although the US government has declared itself convinced, it has, at the time of writing (December 1981), disclosed no more than a fraction of the evidence from which it claims to have drawn this conclusion; and what it has disclosed falls far short of verification. The rest of the world must wait for further US disclosures before it can assess the US conclusions. In the meantime, no more (and no less) credence can be attached to these particular reports than to any of the others on the lengthy list of unverified and unrefuted allegations of chemical warfare that have been made in recent years. They are summarized in table 10.6, together with recent allegations of biological warfare. It will be seen from this table that the governments implicated in the reports include those of China, El Salvador, Ethiopia, Iraq, Laos, South Africa, the USA, the USSR and Viet Nam.

Inconclusive though the evidence so far released by the US government[5] may be, it has been sufficient to create a powerful polarization of opinion on the truth of the matter. On the one hand are those who see nothing more than propaganda in the releases: an attempt by the US government to inflame opinion against the Soviet Union for a variety of general and specific motives; or a replay of the Cold War rhetoric heard when the United States was accused of using biological weapons during the Korean War. The remarkably crude manner in which the US State Department disclosed the existence of evidence concerning toxins—specifically, epoxytrichothecene mycotoxins found in physical samples taken, it was said, from the environment of reported toxic-attack sites in Kampuchea and Laos—during September–November 1981 lent much support to this

[5] Official US government comment on the allegations first appeared in an exchange of correspondence between the State Department and Congressman J. Leach, released by the latter to the press on 11 October 1979; the correspondence included records of interviews conducted by US Foreign Service Officers in Thailand with refugees who had been eye witnesses of purported toxic-agent attacks in Laos. Testimony by Administration officials on the allegations (by then supplemented by reports of chemical warfare in Kampuchea) before a House Foreign Affairs Subcommittee reproduces the State–Leach correspondence, as well as records of further interviews with refugees conducted in Thailand by a Defense Department team [107]. On 24 April 1980 (by which time there were further allegations, relating to Afghanistan) there was further Administration testimony to the Congress [108]. On 7 August 1980, the State Department released a compendium of press and abbreviated intelligence reports on the use of chemical weapons in Afghanistan, Laos and Kampuchea [109], following it up with an update in March 1981 [110] and, later, a fact sheet on the finding of mycotoxins in a sample of vegetation said to have come from Kampuchea [111]. On 10 November 1981 Administration officials testified on the allegations before a Senate Foreign Relations Subcommittee [105]. Additional evidence has been transmitted to the UN Secretary-General both in documents that have since been published [112, 113] and orally [114]. There have also been many leaks to journalists (see especially reference [46]).

view. On the other hand are those who are convinced by the sheer volume, variety and strength of the evidence and who regard those who criticize it and demand yet more as, at best, wilful obscurantists. They have no doubt that the CBW arms control regime has been flouted—and, by extension, that no-first-use policies are no longer warranted, and that further effort to negotiate more CBW arms control should be abandoned forthwith.

This is the worst possible situation. Even if the regime is not in fact being flouted, a lot of people think that it is, including people in government who are likely to influence national policies on CB weapon use and CB arms control. If the reports are true, the rhetoric that has now become attached to them will make it still more difficult for the international community to develop the impartial investigatory machinery whereby the truth can be established, which is an essential prerequisite for salvaging whatever may be left of the arms control regime.

Nor are the chemical and toxin warfare charges the only cause for concern. In March 1980 the US government announced that it was seeking clarification from the Soviet government about a matter which, on the information then available to Washington, seemed to suggest that the USSR was acting in violation of the 1972 Biological Weapons Convention. In contrast to the mycotoxin charges of September 1981, the US government did not claim that it had firm evidence: merely that it had grounds for suspicion. Why Washington should have gone public on the matter—and to have done so just as states parties to the Convention were convening in Geneva for the conference required under the Convention to review its operation over the five years that it had been in force—is not clear. The US Embassy in Moscow had raised the matter privately with the Soviet Foreign Ministry, but only one day before the State Department announced it at a press conference, thereby almost guaranteeing that any subsequent bilateral US–Soviet consultations on the matter would be confrontational rather than co-operative, as indeed proved to be the case. Without co-operation there can be no hope of resolving the affair, for its nature (outlined below), is such that the US government can neither allay nor substantiate its suspicion, nor can the Soviet government respond adequately to US doubts, without frank bilateral discussions at the technical level in which each side puts forward for joint scientific scrutiny information of a type it would otherwise not disclose. The attempts that have been made to effect such contacts have so far proved fruitless; and the allegation festers on. As with the toxin-warfare charges, many people—largely, it would seem, through ignorance of the details of the affair—believe that the US suspicions are well founded, and that the episode provides a clear instance of the USSR not abiding by its agreements on arms control. The US government continues to refer to its suspicions, and is now doing so within the context of its toxin-warfare charges [105].

The event which had stimulated the US action was an outbreak of human anthrax some eleven months previously in the region of Sverdlovsk. For reasons which have yet to be explained in public, some US officials believed that the outbreak was due to an airborne release of anthrax spores following an explosion in a nearby military facility. The Soviet government subsequently ascribed the outbreak to consumption of meat from anthracose domestic animals [115], and published both an authoritative (but sketchy) epidemiological analysis of the outbreak [116] and an account of the criminal proceedings that had been brought against two people whose activities had apparently initiated the outbreak [117]. To specialists in infectious disease and public health matters, including the World Health Organization, Sverdlovsk has long been known as an area where anthrax is endemic. American evaluators are sceptical of the Soviet explanation primarily because their information on the appearance of the disease as experienced by its victims in Sverdlovsk provides no irrefutable evidence that it was the intestinal form of anthrax that was manifest rather than the pulmonary form.[6] The evaluators are said to have evidence in support of the latter diagnosis, albeit of a quality that is far from irrefutable, backed up by a history of suspicion on the part of the US intelligence community that the military facility where the originating explosion was said to have occurred was indeed a biological-warfare installation, though not necessarily one that was illegal under the terms of the 1972 Convention. These latter suspicions had been allowed ample room to grow by the absence of any verification provisions in the Convention which would have enabled their resolution.

Since the Sverdlovsk allegations, the Soviet news agency Tass has suggested that the current epidemic of atypical pneumonia in Spain, which the Spanish government is ascribing to consumption of adulterated cooking oil, might have been due to a leakage of viruses from biological weapons stored in the US air base at Torrejon, near Madrid [125, 126]. The suggestion has been rejected by US government spokesmen, who have stated that all US stocks of biological weapons had been destroyed by 1973 [127].

Reaction against chemical disarmament negotiations

When a government commits a particular military capability to arms control negotiation, that capability comes to serve utilities other than purely military ones. It acquires diplomatic value, becoming part of the

[6] The US Administration has itself made no direct disclosure yet of its information on the Sverdlovsk affair, though there has been secret testimony to Congress [118]. Some of this information has, however, been disclosed by individual US officials to journalists on an unattributable basis. Comprehensive reviews have been published of these sources [119–124].

currency of intergovernmental transaction. Deals may be struck, favours offered or withheld, signals transmitted, through inflexions of negotiating position. These inflexions may have rather little to do with the characteristics of the capability under negotiation. We may, for example, see the emergence of US–Soviet agreement on biological disarmament during 1969–71 as a deliberate and reciprocal gesture of commitment to the path that led to the SALT agreements. Such linkage into the wider reaches of international relations has not been absent from the chemical disarmament negotiations, although so far its influence on the latter appears to have been mainly negative.

This diplomatic utility may enhance the status of supply-led armament, for it can both supplement and stimulate demand rooted in military utility. Otherwise, only precariously justifiable on security grounds, that armament may then acquire additional *raison d'être*; and where actual disarmament is the objective of the arms control negotiation in question, the heightened demand may become transmuted into pressure against a successful outcome. In the case of chemical weapons two particular mechanisms can be described.

First, the weapons may be considered in isolation from the broader military context which sets their true significance. This is inevitable in negotiations concerned only with one family of weapons. The pros and cons of retaining them or bargaining them away come to be examined microscopically and unrealistically. People who are thought to know about the weapons address previously unattainable policy-level audiences that are motivated to take seriously whatever they are told by the experts about the value of the weapons. Down a microscope things look large. Is it purely coincidence that voices from within the Western defence community should have started announcing the existence, not only of a chemical-warfare gap *vis-à-vis* the Soviet Union, but also the great dangers of such a gap, so soon after the negotiations, in the summer of 1977, became joined in earnest?

The second mechanism is driven by the first. The more important the weapons come to appear, the more will seem to be at stake in agreeing to forswear them. The possible consequences of an adversary cheating under the agreement will appear increasingly serious, thus raising the demands for stringent verification. If other negotiating partners fail to accommodate these demands (which, when translated into international inspection procedures, say, may be deeply intrusive), that may appear as evidence that they are not negotiating seriously, even that they are exploiting the negotiations in order to freeze a favourable imbalance in chemical-warfare capabilities by strengthening domestic political constraints on upgrade or 'modernization' activities. The idea may then take hold that further progress towards agreement can result only by removing that imbalance; by building up existing chemical-weapons capability so as to be able to negotiate from a position of strength.

These are precisely the sentiments that are now being expressed by the US Defense Department [25]. In the Geneva talks, the USSR has done little to assuage them, which has had the effect of further encouraging them.

The more the pressure for 'bargaining-chip' chemical rearmament mounts, with its attendant possibility of counter-rearmament, the greater become the potential costs of failure in the chemical disarmament negotiations.

New technology

The dominant trend in CB weapon design over the past 60 years continues to display itself in the research and development activities that lie at the heart of supply-side pressure. The trend is one of weapon designers continually striving to make their products more conducive to integration within prevailing military doctrine and tactical organization, thereby diminishing those opportunity costs of integration which are the main reason why CB weapons remain poorly assimilated [21a, 22, 23]. CBW agents that are slow to take effect, thus demanding peculiar operational planning for their employment, have given way to quick-acting agents which, for this reason, more closely resemble conventional weapons. The agents have long ceased to be packaged within munitions that cannot be used with conventional weapon systems, so that there is no longer any call for special chemical troops[7] armed with the successors of the heavy poison-gas cylinders and projectors of World War I. The latest innovation in this vein is that of 'binary' nerve-gas munitions. These are shells, bombs or rocket warheads filled not with actual nerve gas but with separable loadings of much less toxic chemicals adapted to mix and react together to generate nerve gas only when the munition is on its final target course. Inevitably less powerful as weapons than their single-fill analogues (because the binary reaction generates by-products and/or side-products which dilute the disseminated nerve gas), binaries do away with the need for expensive and dangerous supertoxic-chemical factories, and have sufficiently enhanced storage and handling safety to allow combat units to carry supplies with them instead of having poison gas available only through special channels from distant rear-area depots [128].

For reasons to do with domestic political factors it has been the United States that has been at the forefront of binary-munition technology. Plans exist for transforming most if not all of the US poison gas stockpile into

[7] Those states that have special formations of chemical troops in their forward combat organizations, such as FR Germany and the USSR, have them solely for anti-chemical protective duties, especially decontamination and reconnaissance, not for operating chemical weapons.

binary munitions. The first of them, a 155-mm howitzer projectile for sarin, completed development and became ready for production in 1977. Other than pilot-scale manufacture for developmental purposes, however, there has as yet been no quantity production of the munition. As shown in table 10.7, at least 15 other US binary-munition concepts are at various stages of research and development.

The binary concept can of course be used for poisons other than nerve gases. It lends itself to, for example, the exploitation of poisons that are too unstable for use in single-fill munitions. In fact it was for this purpose that the concept was first studied during World War II, though for agents such as arsine and KB-16 which no longer have any special military attractions.

Within the tight constraints currently imposed by the prevailing forms of military organization and doctrine, one may identify two particular lines of technical development that could generate militarily attractive new CB weapons. Were the constraints to loosen, as they might should existing chemical weapons become fully assimilated, there are several other potential growth areas that military establishments might judge worth developing; but such possibilities are further into the future, and will not be discussed here.

One of the lines of development is towards new toxic agents which combine rapidity of action with casualty-effectiveness at dosages maybe 30–300 times smaller than the nerve gases. Novel agents displaying lesser increases than this in their toxicity would probably not be worth developing, for they would not provide the particular additional utilities that seem to make this line of development militarily attractive. These are referred to elsewhere [2d]. There are no clear signs yet that poisons fulfilling the requirements have been discovered. Among the toxins there are several substances possessing the requisite toxicity but none that are also quick to act. If candidate agents did emerge they would almost certainly be too dangerous to handle and use except by means of binary technology.

The other line of development is towards agents that are no less effective than the nerve gases in causing rapid casualties at low rates of munition expenditure but which have a much diminished probability of actually killing their casualties. Such agents, which form the category of 'casualty incapacitants', could provide several additional utilities. A non-fatal casualty may require evacuation and medical care, thus burdening enemy logistics. The casualties will survive as a demoralizing influence on combat units or as a terrifying influence on civilian populations, an influence which will increase in proportion to the hideousness of the agent's toxic effects. That is one subcategory of casualty incapacitants. A second subcategory comprises agents whose lethality at casualty-producing dosages is likely to be no more than one or two per cent, and from whose toxic effects their

Table 10.7. Projected US binary nerve-gas weapons

Weapon having projected binary delivery capability: Type	Status	Max range (km)	Current nerve-gas ammunition	Projected binary munition(s) for the weapon: Type (see also *Note on agents* below)	Chronology (as evident from published sources): Concept development	Full-scale development	Ready for production
Emplaced landmine systems	In service	0	2-gal VX	Mine	In progress FY78	—	—
Mortar, 81-mm	In service (M29)	4.6	none	Cartridge	In progress FY81	—	—
(Recoilless rifle, 106-mm)	(No longer in US service)	(7.7)	(none)	(Cartridge)	(In progress FY72)	(—)	(—)
Howitzer, 155-mm	In service (M109A2 etc.)	18.1	GB and VX	GB2 projectile (M687)	In progress FY69	Began FY72	FY77
				IVA2 projectile	Completion expected FY81	—	—
Howitzer, 8-in	In service (M110A2 etc.)	21.3	GB and VX	VX2 projectile (XM736)	In progress FY72	Began FY74	Due FY81
				GB2 projectile	In progress FY72	—	—
				130- & 155-mm FSDS projectiles	In progress FY78	—	—
Multiple rocket launcher, 227-mm	Expected in service FY83 (MLRS)	>30	none	Rocket warhead	In progress FY81	Imminent	—
Short-range ballistic missile	In service (Pershing Ia)	720	dev curtailed in 1960s	Missile warhead	In progress FY71, FY82	—	—
	In service (Lance)	112					
	In concept development (CSWS)	>200					
Medium-range ballistic missile	Expected in service FY84 (Pershing II)	1 800	none	Missile warhead	In progress FY82	—	—
Intermediate-range cruise missile	Expected in service FY84 (GLCM)	3 200	none	Missile warhead	In progress FY80	—	—
Strike aircraft	In service (F4, F111 etc.)	500–2 400	GB bombs, VX spraytanks	VX2 500-lb spraybomb	Completed before FY67	Resumed FY77	Due FY82
				GB2 cluster bomb	Curtailed FY70	—	—
				VX2 spraytank	In progress FY67	—	—
Attack helicopter/strike aircraft	In service (AH-1 etc.)	< 600	none	2.75-in FFAR	In progress FY73, FY77	—	—
Attack drone	In development (RPV)	..	none	?	In progress FY80	—	—

Conventions: MLRS—multiple-launch rocket system; CSWS—corps support weapon system; GLCM—ground-launched cruise missile; RPV—remotely piloted vehicle; FSDS—fin-stabilized discarded-sabot; FFAR—folding fin aircraft rocket; FY—fiscal year; dev—development.

Note on agents: Four categories of nerve gas are under study as binary-munition products: nonpersistent, persistent, intermediate volatility and highly persistent. For the nonpersistent and persistent categories, the agents of choice have been binary sarin (GB2) and binary VX (VX2) respectively. The agents disseminated by GB2 and VX2 munitions are thus identical with the currently stockpiled nerve gases, except that, as disseminated, they are diluted with unreacted precursors, byproducts and/or side-products and are therefore less toxic and more readily detected. It is possible that these two agents will be replaced by a single agent from the Intermediate Volatility Agent (IVA) category, some of the resultant IVA2 binaries disseminating the IVA in thickened form, others in unthickened form, depending on the degree of agent persistence sought. However, IVA2-munition development is lagging because of failure as yet to find an appropriate agent. Included among those nerve gases that have been studied as candidate IVAs are several novel and still-secret ones (such as EA 5365, finally rejected in FY79, and the 'volatile analogs of binary VX' under consideration in FY78); the present signs are that the eventual choice will be soman (agent GD), in which case the binaries that emerge from the R&D programme after the BLU-80/B (Bigeye) VX2 spraybomb—the warheads for MLRS and the Lance-follow on CSWS, the Pershing II and/or the GLCM, or, less probably, projectiles for the Lightweight Mobile Binary Lethal Agent System for which prototype 81-mm mortar rounds are currently serving as test vehicles—may be GD2 munitions. Little information has yet been publicly released about the Highly Persistent Agent category, either on the agents under study or on the interest attaching to the category.

Sources: US Department of Defense data referenced in Perry Robinson, J.P., 'American chemical-warfare capabilities: collated data and estimates' (unpublished), and 'Binary nerve-gas weapons', in *Chemical Disarmament: New Weapons for Old* (Almqvist & Wiksell, Stockholm, 1975, SIPRI), pp. 21–99.

victims can recover without medical treatment. The utility of such agents would lie, as with tear gases in the hands of police forces, in reducing the political costs of exerting armed force; they could, for example, be thought to facilitate combat within areas populated by non-combatants.

Formal military requirements for the second subcategory of casualty incapacitants have long existed with the US armed services, and over the years a number of agents meeting them have been standardized only to be abandoned because of subsequently apparent shortcomings. They include phencyclidine (agent SN), 3-quinuclidinyl benzilate (agent BZ) and type B staphylococcal enterotoxin (agent PG, formerly agent UC). The search continues. As of 1977 the leading contender was something known in public only as EA 5302, which is a solution of a psychotropic glycollate related to BZ (EA 3834B) in a novel volatile irritant liquid coded EA 4923, apparently a cycloheptatriene [129].

The principal feature demanded of agents in the first subcategory is that they should have debilitating effects falling short of high mortality over as much as possible of the range of dosages likely to be establishable in the field. Examples include such long-familiar chemical warfare agents as mustard gas and the arsenicals—such as diphenylcyanoarsine at the lower-lethality end of the range or the lewisites at the higher-lethality end. If what the US Government has recently alleged concerning toxin warfare is correct, it seems that the 12,13-epoxytrichothecenes must now also be included in the subcategory. However, the very fact that the subcategory contains so many other less exotic toxic agents affording comparable target effects is itself reason to doubt the allegations. About the only relative advantage the compounds appear to possess is that they could be quite easy to produce in quantity from readily available starting materials without recourse to a developed chemical industry.

Be that as it may, it is from the general field of toxins—naturally occurring poisons—that threatening new toxic-weapon technology seems most likely to emerge. There is another reason for supposing this. It lies in the present efforts of the chemical and allied manufacturing industries to reduce their dependence upon oil and refinery products. This shift away from a petroleum base could well stimulate heavy investment, as is happening in some countries already, in biotechnology—which is to say that category of process technology which relies on manipulating the behaviour, physiology or structure of living organisms in order to produce substances that are useful to man or otherwise marketable. Fermentation, enzyme catalysis and biosynthesis all fall within the category, and all seem capable of providing, possibly on a very large scale, a range of highly toxic substances (lethal or incapacitating), the full extent of which can at present only be guessed. This range could include candidate CBW agents that are currently regarded, within the perspective of petroleum-dominated chemical economies, as inaccessible on a scale large enough for use in war. How confident can we be that this incipient shift of the chemical manufacturing industry will not generate new pressure for the supply of toxic weapons?

IV. Responses to the threats

The developments described under the five subheadings above constitute threats of one sort or another to the existing CBW arms control regime. By the same token they represent threats to the national security of individual states. The responses to them have accordingly been of two broad types: diplomatic and military.

Diplomatic responses

First and foremost are the intergovernmental negotiations on chemical disarmament. These date back to 1968 when the subject of CBW entered the agenda of the Geneva disarmament committee, at that time still the ENDC. Exploratory talks then opened on the possibility of additional CBW arms control. After conclusion of the 1972 Biological Convention, the talks did not advance into actual negotiations on chemical weapons until 1977. This occurred not within the Geneva disarmament committee (by then the CCD) but within a private bilateral working group that the USA and the USSR had then established, after preliminary consultations the previous year, for the purpose of developing the 'joint initiative' for the CCD which had been promised in the Nixon–Brezhnev communiqué from the Moscow summit meeting of June–July 1974. Areas of broad bilateral agreement were registered quite quickly by this group, including the objective of a comprehensive treaty rather than the partial one implied in the 1974 communiqué. By 'comprehensive' is meant a convention obliging states parties "never to develop, produce, otherwise acquire, stockpile or retain supertoxic lethal, other lethal or other harmful chemicals, or precursors of such chemicals"—an obligation which would not, however, "extend to those substances in these categories which are intended for non-hostile purposes or military purposes not involving the use of chemical weapons" [130]. This rather complicated language reflects much negotiation on points of detail, including possible approaches to verification. Analytical commentaries are available [41c, 55, 131].

Contrary to what many commentators on the negotiations have been suggesting, bilateral agreement has also been registered on the use of on-site inspection as a verification technique [130]. This agreement so far extends only to use of the technique in a voluntary, challenge mode, not in the obligatory and routine fashion for which the West is calling. The basic practical question here is whether, and if so in what manner and with what degree of access, foreign observers should be present during stockpile-destruction operations. By the tenth round of bilateral talks, in the summer of 1979, it was said that a mutually acceptable compromise was coming into sight. But further substantive progress became all but impossible after the Soviet occupation of Afghanistan, and, although there have been two more rounds of talks, both during 1980, the Reagan Administration has effectively curtailed the enterprise, showing no sign throughout 1981 of reviving it.

By establishing the bilateral working group, the USA and the USSR effectively prevented the other members of the Geneva disarmament committee from negotiating on chemical disarmament; and with the slackening of bilateral progress and the readiness of both France and China to discuss chemical disarmament, demands became increasingly strident for the committee to reassume the negotiating role with which the UN General Assembly had charged it. In 1980 a compromise was reached; the committee, by then the CD, established an ad hoc working group "to define, through substantive examination, issues to be dealt with in the negotiation on" a chemical weapons convention. This paltry mandate has now largely been exhausted, though in the process the Ad Hoc Working Committee, under the chairmanship of Japan and then of Sweden, has done much useful sifting and sorting of the highly complex matters that must be resolved before a treaty becomes possible. It remains to be seen, at the time of writing, whether the mandate of the Ad Hoc Working Committee will be expanded during 1982, when the group will be chaired by Poland, in such a way as to compensate for the absence since July 1980 of any negotiating activity within the bilateral US–Soviet working group.

The atmosphere within which these various efforts have been proceeding has been most adversely affected these past two years by the CBW allegations described above. Although the allegations have imparted a new sense of urgency and have also demonstrated the importance of verification provisions, they have brought feelings of mistrust to such a pitch that the stringency of the verification measures now being advocated—and not only by the West—has reached a level that will almost certainly be impossible to put into practice, still less to agree upon beforehand.

As a product of the 1980 Review Conference there is now agreement among states parties to the 1972 Biological Weapons Convention that any party has the right to request the convening of a consultative meeting at expert level and open to all parties [132]. An embryonic mechanism thus exists whereby further clarification of the Sverdlovsk anthrax episode and of the mycotoxin affair might be gained. With regard to the use allegations, the UN General Assembly (by a vote of 78 to 17 with 36 abstentions and 22 absentees in December 1980) empowered the Secretary-General to convene an expert investigatory group so that he could report on the matter the following year [133]. The diplomatic furore surrounding the birth of the investigatory group, with the division of the General Assembly vote emphatically along East–West lines and a clear disinclination on the part of prominent sectors of the non-aligned world to become involved, did not augur well for a conclusive report. Nor were the resources and time available to the group sufficient for a comprehensive investigation, still less with the Americans springing a whole lot more pertinent information just as the group was finalizing its report.

The report as released in mid-November 1981 [114] did indeed observe that the group had "found itself unable to reach a final conclusion as to whether or not chemical warfare agents had been used". Even so, to anyone who has been following the allegations at all closely, the report is an impressive piece of work: its depth of inquiry, the astuteness of its technical considerations, and its passage through the political minefields of its subject-matter with no precedent to guide it, must be judged a considerable achievement, very much to the credit of the Chairman of the group, Major-General Dr Esmat Ezz of Egypt, and of the UN Centre for Disarmament which serviced the group. The report notes a range of specific technical matters on which detailed evidence is still needed before conclusions can be reached. By a vote of 86 to 20, with 34 abstentions and 16 absentees, the General Assembly subsequently voted to expand the mandate of the Secretary-General so that the investigation could continue [134].

Military responses

The diplomatic response, including disarmament negotiation, is one of the routes whereby states can seek to enhance their security against a weakening of the CBW arms control regime. There are also the military routes of defence, in the form of an enhanced anti-chemical, protective posture, and of deterrence, in the form of a serviceable retaliatory capability, whether chemical or of any other variety. At least until such time as major decisions have to be taken by individual governments about the allocation of resources to future CBW programmes, there is complementarity between the three routes: each one can be followed with relatively little risk of compromising progress along either of the others. This is true for as long as actual agreement on disarmament appears distant. And even if agreement appears imminent, it may still be possible to postpone cutting the military CBW programmes (cuts that might well precipitate sufficient intragovernmental discord to impede the terminal stages of the negotiations) by seeking terms that legitimized at least some military programmes during the transition phase to disarmament after the treaty had entered into force. In this regard it should be noted that the CD now apparently accepts the US–Soviet contention that complete destruction of existing stockpiles may take as long as a decade; and the latest statement from the US Defense Department on this question speaks, moreover, of 15 to 20 years being needed [25]. While stocks remain undestroyed, countermeasures against their possible use during the transition phase are justifiable.

The present juncture, however, is one in which agreement on chemical disarmament no longer appears as close as it once did, and in which the government of at least one of the chemical weapon states has come to believe that the condition of its chemical retaliatory capability has deteriorated to the point where major decisions about its future are essential. This is a most unfortunate conjunction of events. While in theory the complementarity of the deterrence and arms control routes is still valid, in practice the authorization by a government of chemical rearmament cannot fail to weaken international confidence in the good faith of that government as regards its participation in the disarmament negotiations, thereby lessening still further the prospects for agreement. Build-up of anti-chemical protection and maintenance of existing retaliatory capability may appear compatible with continued disarmament negotiation, or at least not incompatible with it; but not the build-up of chemical weapons, however much the latter may be proclaimed as a bargaining chip or, for that matter, as a figment of mendacious propagandists.

We do not know whether France or the Soviet Union are currently expanding their stocks of chemical weapons. We do not know whether countries such as South Africa, Syria, Viet Nam or Egypt—or China, Israel, Pakistan or Libya—have moved to acquire stocks, but we do know that the United States, the world leader of military fashion, is on the verge of chemical rearmament.

In September 1981 the US Defense Department let a contract for the construction at Pine Bluff Arsenal, Arkansas of a full-scale factory for making the first of the new binary nerve-gas munitions; site work was scheduled to commence the following month [25]. According to 1980 plans, the factory would take 32 months to complete, and have a capacity of 20 000 155-mm rounds per month; it would be expanded in three further phases to provide production capacity for more of the 155-mm rounds and for other binary munitions; and if the decision were taken to utilize the capacity, the binary production programme envisaged would run for about 14 years at a cost in the region of $5 billion. These plans have since been expanded by the Reagan Administration. The schedule for completing the 155-mm binary-sarin plant has been brought forward so that the factory will be ready for operation during Fiscal Year 1983; and the schedule for acquiring additional production capacity has been reordered so that the 500-pound binary-VX aircraft spray-bomb (Bigeye) can be next off the production line. Decisions on what is to come after Bigeye were still pending in September 1981, the leading contenders being binary warheads for the new US-German-British-French 227-mm Multiple-Launch Rocket System and the ground-launched cruise missile [25] and possibly also warheads for the successor to Lance, now known as the Corps Support Weapon System [135], and the Pershing II missile.

Production of any of these weapons is contingent, however, upon the President himself making the decision and, as section 818 of Public Law 94–106 requires him, certifying to the Congress that the production is essential to the national interest. This has now been done. As a consequence—assuming that the Congress appropriates the money requested —the world now knows that the status of poison-gas warfare has changed drastically, and that a full-blown chemical arms race is maybe in prospect. The President's budget for Fiscal Year 1983 does indeed seek funding for full scale binary production.

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11. The environmental aftermath of warfare in Viet Nam

Square-bracketed numbers thus, [1], *refer to the list of references on page* 384.

I. Introduction

The Second Indochina War of 1961–75 is noted for the widespread and severe environmental damage that was inflicted upon its theatre of operations, especially in the former South Viet Nam [1, 2a]. This chapter reviews the character and extent of the initial ecological disruption brought about by military actions (primarily those during the late 1960s and very early 1970s) and describes the nature and pace of recovery and some of the related reconstruction efforts made during the first five or so post-war years. The emphasis is upon Viet Nam and especially upon the former South Viet Nam, the region which was most severely disrupted from an environmental standpoint.

As far as is possible the present analysis dwells upon the natural environment and renewable natural resources. It must be recognized, however, that the region in question has long been a heavily populated one, supporting an agrarian society that depends for its survival upon exploiting the natural resources of the region on a continuing basis. The natural and human environments are thus inextricably intertwined there, and matters of post-war recovery and reconstruction must often be treated in tandem.

After a brief description of the land and population of Viet Nam and the strategy and consequences of the Second Indochina War (including a minor digression on dioxin), an outline is given of the post-war status of Viet Nam's major renewable natural resources: its inland forests, coastal mangroves, fisheries, wildlife, and food and industrial crops. In conclusion the lesson to be learned from the Viet Nam debacle is examined.

The land and population of Viet Nam

Viet Nam is a mountainous country dominated by two powerful rivers, the Red River in the north and the Mekong River in the south. Their two deltas and the narrow coastal plain that connects them are devoted in large part to rice cultivation. Overall some 25 per cent of Viet Nam's land surface is in agricultural use, about 67 per cent is considered forest land, and perhaps 1 per cent is covered by inland waters. Table 11.1 summarizes land disposition in the country.

The population of Viet Nam in 1981 was approximately 55.0 million

Table 11.1. Land disposition in Viet Nam, 1979[a]

Category	Area (million ha)	Percentage of total land area	
Agriculture	8.4	*25*	
Rice (paddy and upland)	5.5		*17*
Other cereals (maize, etc.)	1.4		*4*
Other foods	1.0		*3*
Annual industrial crops	0.3		*1*
Rubber	0.1		*0*
Other perennial industrial crops	0.1		*0*
Savanna and pasture	2.0	*6*	
Forest[b]	22.0	*67*	
Inland	21.4		*65*
Coastal	0.6		*2*
Miscellaneous land	0.3	*1*	
Inland waters[c]	0.4	*1*	
Total[d]	**33.1**	**100**	

[a] The values are based on references [3a, 4a, 5a, 6a, 71].
[b] The forest category includes 2.1 million ha of lands not at present covered by trees (14 per cent of the forest category and 9 per cent of all Viet Nam). It also includes 11.1 million ha of commercial forest.
[c] Inland waters include 0.1 million ha devoted to pisciculture [3b].
[d] North Viet Nam 15.8 million ha; South Viet Nam 17.3 million ha (derived from reference [3c]).

and growing rapidly (see table 11.2). There are three large cities—Ho Chi Minh City with 3.4 million inhabitants, Hanoi with 2.6 million, and the nearby port of Haiphong with 1.3 million—and various smaller ones. Nonetheless, an estimated 81 per cent of Viet Nam's population is rural and most of these people are farmers. Approximately 88 per cent of the total population is ethnically Vietnamese, living mostly on the deltas or coastal plain, whereas the remaining 12 per cent belong to some 60 different and more or less primitive, ethnically distinct tribes largely living a semi-nomadic existence in the mountains [4b].

Viet Nam was under French colonial domination and exploitation from the mid-19th century to 1954, was under harsh and even more intensely exploitative Japanese occupation from 1940 to 1945, fought a vicious and draining war of independence from 1946 to 1954, soon again a devastating war from 1961 to 1975, and has had a number of disrupting military involvements since then. The result of a century or so of exploitation, capped by its recent environmental holocaust, is that Viet Nam today stands among the poorest and least economically developed nations in the world. Its renewable natural resource base has been devastated, its infrastructure severely disrupted, and its overall economy shattered. In South Viet Nam there was additionally a dearth of able leaders and other administrators at the end of the Second Indochina War owing to their

Table 11.2. The population of Viet Nam

Year	Total[a] (million)	Rural[b] (million)	Percentage rural of total	Ho Chi Minh City (Saigon)[c] (million)
1960	30.0[d]	25.5	*85*	1.4
1975	47.6[e]	37.4	*79*	4.2
1976	49.2	39.0	*79*	3.6
1977	50.4	40.3	*80*	3.5
1978	51.4	41.3	*80*	3.5
1979	52.5[f]	42.4[g]	*81*	3.4
1980	53.7			
1981	55.0			
1982	56.3			

[a] 1960 datum from reference [7a]; 1975–79 data from reference [3d]; the values for 1980–82 are extrapolations from the 1979 datum using a continuous compound growth rate of 2.4 per cent (based on the populations for 1975–79) which leads to a doubling time of 29 years (see also note *f* below). An estimated 1 million persons emigrated from Viet Nam during 1975–80 [8a].

[b] 1960 datum based on 85 per cent of total estimate [9a]; 1975–79 data from reference [3d].

[c] 1960 datum interpolated from references [10, 11]; 1975 datum from reference [5b]; 1976–79 data from references [3c, 12, 13, 14a].

[d] North Viet Nam 15.9 million; South Viet Nam 14.1 million [7a].

[e] North Viet Nam 24.3 million; South Viet Nam 23.3 million (derived from reference [15]). The growth in population for all Viet Nam during 1960–75 can be calculated to have continuously compounded at the rate of 3.1 per cent (a doubling time of 22 years).

[f] North Viet Nam 26.3 million; South Viet Nam 26.2 million (derived from reference [3c]). The 1975–79 growth rate for North Viet Nam can be calculated to have been 2.0 per cent (doubling time 35 years); for South Viet Nam it was 2.9 per cent (doubling time 24 years); for all Viet Nam see note *a* above. An estimated 41 per cent of the population of Viet Nam is under the age of 15 years [16a]. Over 1 per cent of the population is in the armed forces [17a].

[g] Of the rural population, 37.6 million (or 88 per cent) were in 1979 engaged in agriculture (i.e., 71 per cent of the total population) [8b]. More than 300 000 of the rural population are engaged in fishing [18a].

systematic assassination by the USA (as a part of its so-called Phoenix programme [73]). Its largely agrarian society must cope with an agricultural and associated water conservancy system that was widely damaged by a combination of military actions and forced abandonment and neglect. As a result, Viet Nam is now only about 85 per cent self-sufficient in staple foods and its gross national product per capita falls below $300 (1980 value) [17b, 19]. In the words of a recent United Nations report, "... almost everywhere there is a lack of equipment, spare parts, and repair and maintenance facilities. As a result, it is almost impossible to provide basic everyday services reliably and properly; similarly, the productive capacity of industry is very low and continually deteriorating" [18b].

II. The Second Indochina War

The Second Indochina War of 1961–75 was a complex of more or less distinct conflicts confounded by massive US involvement. The ecological and related consequences of the war have been described elsewhere [1, 2a, 20–23], and a number of very useful bibliographies are available [24–26].

Strategy and consequences

The Second Indochina War can be summarized as an unsuccessful attempt by the USA to prevent the government of the Republic of [South] Viet Nam from being replaced by the National Front for Liberation of South Viet Nam *cum* Revolutionary Government of South Viet Nam or, eventually, from being annexed by the Democratic Republic of [North] Viet Nam, with ancillary US military involvement against Laos and Kampuchea [2b]. The US strategy against North Viet Nam involved heavy bombing and naval shelling in order to destroy systematically industry, transportation networks and all manner of public buildings.

The US strategy against South Viet Nam involved truly massive rural area bombing, chemical and mechanical forest destruction, large-scale crop destruction, destruction of food stores, the destruction of hospitals, and large-scale population displacements—in short, the massive, intentional disruption of both the natural and human ecologies of the region (see table 11.3).

Table 11.3. Hostile actions by the USA against Viet Nam during the Second Indochina War[a]

	Munitions fired		Herbicides sprayed		Land cleared	
Region	(million tonnes)	(kg/ha)	(thousand m^3)	(l/ha)	(thousand ha)	(m^2/ha)
North Viet Nam	1.1	70	0	0	0	0
South Viet Nam[b]	10.2	590	72.4	4.2	325	190
Military Region I	3.3	1 170	12.3	4.4	70	250
Military Region II	2.1	270	15.2	2.0	50	60
Military Region III	4.3	1 430	38.4	12.7	200	660
Military Region IV	0.5	130	6.5	1.7	5	10
All Viet Nam	**11.3**	**330**	**72.4**	**2.1**	**325**	**100**

[a] The data are derived from reference [1]; munitions [1a]; herbicides [1b]; land cleared (by Rome plough tractors) estimated from [1c]; and the regional areas from [1d].
[b] The former military regions of South Viet Nam are depicted by SIPRI [1e].

The loss of life in Viet Nam during the war was enormous: an estimated 1.5 million Vietnamese were killed, representing 4 per cent of the population (3 per cent in North Viet Nam and 5 per cent in South Viet Nam) [2c]. Moreover, non-fatal casualties must have exceeded three times that number. Wartime population displacements in Viet Nam involved some 10 million people at one time or another, primarily in South Viet Nam (i.e., over half its population) [27].

Of the major cities in North Viet Nam, Haiphong and essentially only the outskirts of Hanoi were bombed. All five of North Viet Nam's industrial centres were demolished [9b, 23a, 5c]. All 29 provincial capitals were bombed and 12 of them razed; 96 of its 116 district capitals were bombed and 51 of them razed; and about 2 700 of its 4 000 or so rural villages were bombed and 3 000 of them razed. Virtually every railway and highway bridge was destroyed as were many hundreds of public buildings. In the process, many hundreds of water conservancy works and irrigation dikes and much farmland and livestock were damaged or destroyed. Countless unexploded munitions remained at the end of the war that continue to cause scores of casualties annually, many of them fatal.

About 9 000 of approximately 15 000 rural villages in South Viet Nam were damaged or destroyed and millions of people were driven into Saigon, Danang, Hue and other urban areas [5d, 9c, 23b]. Saigon swelled from a pre-war population of 1.4 million to 4.2 million (table 11.2). When the war ended, South Viet Nam was burdened with more than 600 000 war orphans, several hundred thousand war widows, about 400 000 invalided war cripples, some 3 million unemployed, of the order of 600 000 prostitutes and an estimated 500 000 drug addicts [28]. As in North Viet Nam, there remains a legacy in South Viet Nam of unexploded munitions that each year kill and maim scores of those who must work the land. Millions of South Vietnamese at the end of the war suffered from such serious ailments as malaria, tuberculosis, leprosy, bubonic plague, poliomyelitis, venereal diseases and psychiatric disorders [29].

Throughout Viet Nam some 360 000 disabled war victims of labouring age (both military and civilian) currently receive governmental compensation, 140 000 of whom are totally disabled and the remainder partially so [28a]. These numbers do not by any means represent all such war casualties. Moreover, there exist throughout Viet Nam today 1.1 million war orphans who have lost both parents, many of whom have nutritionally based and other disabilities. The number of rehabilitation centres in the country is far from adequate and the available ones are understaffed with trained personnel and inadequately equipped.

Finally, the Second Indochina War resulted in massive damage to field and forest especially in South Viet Nam, the subject of the following sections. Here it suffices to stress that this was an innovative war in that a great power attempted to subdue a peasant army through the profligate use of technologically advanced weapons and techniques. A number of these weapons and techniques were inescapably anti-ecological, especially those employed against the land and people of South Viet Nam. The result in South Viet Nam was the widespread, long-lasting and severe disruption of forest lands, of perennial croplands and of farmlands—that is to say, of millions of hectares of the natural resource base essential to an agrarian society.

The dioxin question

During the Second Indochina War a substantial quantity of dioxin (2,3,7,8-tetrachlorodibenzo-*para*-dioxin, or TCDD) was inadvertently disseminated into the South Vietnamese environment as an impurity of so-called Agent Orange, the most widely and heavily used of the several anti-plant chemical warfare agents employed by the USA [1f, 30]. Dioxin is briefly singled out here owing primarily to its notoriety as a highly potent human toxin and teratogen, and its apparent mutagenic and carcinogenic effects on humans.

It is not possible to establish the exact quantities, locations and dates of dioxin application. A conservative early estimate of the total quantity of dioxin applied was 110 kg [1g], whereas a recent estimate based on somewhat more complete information is 170 kg [31]. An estimated 90 per cent of the dioxin was disseminated during 1966–69. It was applied to about 1 million hectares of South Viet Nam, approximately 90 per cent as part of the anti-forest programme and the remainder as part of the anti-crop programme. About two-thirds of the affected area received of the order of 110 mg/ha of dioxin, although multiple applications caused some areas to be subjected to two to five times this amount. The several provinces surrounding Ho Chi Minh City, that is, the former Military Region III (including so-called War Zones C and D and the Iron Triangle), received more than half the total amount.

The amount of dioxin that remains in the environment following application to an area diminishes with time owing primarily to degradation and dissipation. It appears that of the order of half the amount of aerially applied dioxin decomposes within a few days, with the remainder becoming more permanently incorporated into the ecosystem, that is, into the soil and biota [32, 33]. Once thus incorporated subsequent disappearance can be assumed to follow an exponential decay curve (i.e., follow first-order kinetics) and is thus expressible in half-lives. On the basis of some published field data from Florida, USA, this environmental half-life for dioxin has been calculated to be 2.9 years [30a]. More recent field data from the same location [34] permit a similar calculation to be made that gives a somewhat more reliable value of 3.5 years. In the case of Viet Nam, if one makes the simplifying assumption that the estimated 170 kg of dioxin had all been introduced in 1968, then perhaps 8 kg remained at large in 1980, 3 kg will be present in 1985, and 1 kg in 1990.

Dioxin appears not to be toxic to plants and thus can be assumed to have had little if any effect on the vegetation of Viet Nam, either natural or cultivated. Moreover, in the amounts involved its effect on indigenous wildlife populations appears at worst to have been transitory and therefore probably negligible. However, it is possible, not to say likely, that occasional heavy localized applications of dioxin resulted in some wildlife and livestock losses, especially perhaps of poultry [35a].

The question of whether the applied dioxin had a health impact on the indigenous human population of Viet Nam is still under active investigation there [36]. The possibility of long-term health effects on US troops that had been exposed during the war is also a matter of continuing concern [37]. The fact that dioxin is mobile in the environment and can move up a food chain that culminates in humans, perhaps concentrating somewhat in the process [30b], lends credence to the possibility of dioxin-related human health problems in Viet Nam.

III. The post-war status of Viet Nam's renewable resources

To a major extent Viet Nam must depend upon the renewable natural resources that can be derived from its forests, fields and waters (both inland and nearby ocean) for its industrial raw materials and as items for export in exchange for imported oil and other crucial basic commodities which the country lacks. The following sections summarize several major renewable resources.

Inland (upland) forests

Forest lands cover two-thirds of Viet Nam (table 11.1) and trees must be counted among the nation's most important natural resources [5e, 38–43]. The forests, which are divided more or less evenly between North and South Viet Nam, now provide the nation with almost 2 million cubic metres per year of timber plus large amounts of fuel wood (table 13.4). The present section dwells upon the inland (upland) forest (comprising 97 per cent of the total), whereas the next section deals with the coastal mangrove forest (accounting for the remaining 3 per cent).

The inland forests of Viet Nam—11.1 million ha of which are considered to be commercially exploitable [1h, 43a]—support some 200 commercial species, a dozen or more of which are of exceedingly high quality and suitable for the world market.

The forests of Viet Nam are considered to be in generally poor condition owing to a variety of factors. They were casually exploited for many decades during the French colonial period and ruthlessly exploited by the Japanese during World War II. They were badly damaged during the Second Indochina War. Perhaps most importantly, they have been degraded as a timber resource by centuries of shifting slash-and-burn agriculture by Viet Nam's 60 or more primitive hill tribes, especially severely in recent decades. Recent population increases among these

Table 11.4. Forestry and forest products in Viet Nam[a]

Year	Sawnwood production[b] (million m^3)	Sawnwood per unit area[c] (m^3/ha)	Sawnwood per capita[d] (m^3/cap)	Paper production[e] (thousand tonnes)	Lumber export[f] (million m^3)
1960	2.5[g]	0.23	0.083		
1975	1.3	0.11	0.026	42	0.00
1976	1.7	0.15	0.034	75	0.02
1977	1.7	0.15	0.033	71	0.05
1978	1.7	0.16	0.034	69	0.06
1979	1.8	0.16	0.033	54	0.07

[a] In addition to the timber (roundwood) removals, fuel wood (firewood plus charcoal) is cut at the annual rate of perhaps 0.36 m^3/cap, i.e., for a nation-wide total now of the order of 19 million m^3/yr [44], or perhaps somewhat more [5f]. However, apparently only of the order of 2 million m^3/yr of this is derived from Viet Nam's commercial forests [38a, 41a].
[b] 1960 datum combined from references [38a, 41a]; 1975–79 data from references [3e, 14b].
[c] Based on a commercial forest area of 11.1 million ha.
[d] Based on population figures from table 11.2.
[e] From references [3e, 14b]. A modest fraction of Viet Nam's paper is not derived from bamboo or other tree fibre.
[f] From references [3f, 14c].
[g] North Viet Nam 1 million m^3; South Viet Nam 1.5 million m^3.

national minority groups and a declining area of land available to them have inevitably led to a slash-and-burn rotation too brief for adequate rejuvenation of the exploited land. An estimated 10 000 ha are cleared in this way in North Viet Nam each year [41] and presumably as much again in South Viet Nam.

The almost 6 million ha of commercial forest in South Viet Nam were especially hard hit during the Second Indochina War by a combination of chemical attack, bombing and tractor clearing (so-called Rome ploughing) [1, 5e, 45, 72]. Over a period of about a decade the USA expended about 10 million tonnes of high-explosive bombs, shells and the like against South Viet Nam (table 11.3) [1i]. The damage that can be attributed to this assault on the rural reaches of South Viet Nam is best presented in two stages, complete obliteration and severe damage. The first category consists of that land (to a very large extent forest land) which was converted to craters by the high-explosive munitions. Such crater-obliterated areas add up to just over 100 000 ha, perhaps 1 per cent of the entire South Vietnamese forest. Among many small artillery craters, an estimated 10 to 15 million large bomb craters were created in South Viet Nam and these have for the most part become a semi-permanent feature of the regional geomorphology. The second category consists of that land which was subjected to flying metal fragments (shrapnel). The zone subjected to such abuse at an intensity lethal to 50 per cent or more of exposed personnel amounts to almost 5 million ha, representing over 40 per cent of the total forest lands of South Viet Nam. This last defined area is one in which many of the trees present were injured by shrapnel, an event that particularly in the tropics leads to fungal entry and decay, inevitably followed by a significant proportion of tree mortality.

The damage caused by chemical anti-plant agents to the forests of South Viet Nam is also best presented under two headings: virtually complete obliteration; and partial damage [1f]. The first category comprises the upland forest land that was sprayed four or more times. This category of virtual obliteration covers about 50 000 ha. The second category comprises upland forests that were sprayed one to three times. This area has been calculated to cover some 1.3 million ha (12 per cent of South Viet Nam's total forest). The first of these categories is estimated to have experienced between 85 and 100 per cent tree mortality, whereas the second experienced between 10 and 50 per cent.

The environmental disruption attributable to the 200 or so huge Rome plough land-clearing tractors is easy to summarize [1c]. This bizarre category of complete tree removal and topsoil disturbance amounted to some 325 000 ha, that is, approximately 3 per cent of the total South Vietnamese forest lands.

Combining the several separate estimates of damage presented above by simple addition would inflate the extent of damage since some of the areas were subjected to more than one category of insult. The summations are therefore reduced by 10 per cent to allow for such overlap. Thus, complete or essentially complete devastation of South Viet Nam's upland forests occurred to an estimated 417 000 ha, representing about 4 per cent of its total forest lands. The partially damaged forest lands are estimated to have covered at least an additional 5.6 million ha, or just over half of them.

In terms of primary forest products, the military damage described above has been estimated to have resulted in as much as 75 million m^3 of destroyed timber, assuming that each hectare of commercial forest had an average pre-war merchantable stocking of 90 m^3 [2d]. This amounts to about 14 per cent of the standing merchantable timber crop of South Viet Nam (or to about 8 per cent for all Viet Nam). Moreover, with the assumption of a growth rate of 0.6 per cent per year, it will take Viet Nam's 11.1 million ha of commercial forest perhaps 13 years to make up this loss without any concomitant harvesting; or, somewhat more realistically, about 40 years with a continuing harvest of 4 million m^3/yr (the approximate current value of timber plus fuel wood removals; see table 11.4). The effects of particulate erosion and nutrient dumping (loss to the soil of nutrients in solution) will reduce the annual increment in the badly damaged areas, thereby extending the overall recovery period somewhat, as will increased removals. Conversely, artificial regeneration (planting) will shorten it.

In the upland forests of South Viet Nam which had been heavily damaged during the war the land is now again fully occupied with vegetation except for some steep areas in which erosion and forest fires had exposed bedrock. The replacement vegetation is in many of the heavily damaged areas comprised almost entirely of herbaceous grasses and in others of shrubby bamboos. Standing dead tree trunks, killed during the war, are still widely in evidence and regularly harvested, some for timber but mostly for fuel. In some parts of the country, for example in Tay Ninh province, large areas of destroyed forest have recently been, or are in the process of being, converted to agriculture as part of the new frontier or new economic zone programme.

Viet Nam's pre-war merchantable cut of 2.5 million m^3/yr was reduced to just over half that level at the end of the war and has crept up only slightly since then (table 11.4). This has been in part the result of wartime decimation in highly accessible timber stands (e.g., in the former War Zones C and D) as well as of the destruction of forest industries, of which half were damaged or destroyed [5g]. Lack of spare parts and fuel for logging, transporting and milling equipment has further hampered post-war recovery of the industry. Moreover, unexploded munitions and craters have hampered logging considerably. The rural road system needed for timber transportation is in a bad state of repair. Metal fragments in the logs seriously impede sawmilling [5h, 39]. The increasing demands of a growing population for fuel wood and for some of the forest land itself for agriculture have also contributed to the reduced harvest.

Natural processes of forest growth and of ecological succession are helping to heal the wounds of war in Viet Nam's upland forests. Pioneer vegetation became established quite quickly in most of the heavily damaged areas, thereby arresting further erosion and nutrient dumping. However, the tenure of this pioneer vegetation of herbaceous or woody grasses—which precedes the re-establishment of the desirable dicotyledonous trees—is measured in decades. Artificial regeneration is thus often called for, despite the trouble and long-delayed return on investment involved. Indeed, even before the end of the war Viet Nam initiated a modest reforestation programme, of several thousand hectares per year, much of it to counter erosion brought on by bombing damage [41]. Today, a number of new nurseries have been established in both North and South Viet Nam in which some 10 species of native and exotic trees (including teak and pine) are being raised for outplanting [46]. Current national plans call for the reforestation of 1.5 million ha and, according to one source, about 100 000 ha have been replanted annually since the end of the war [47, 48].

In conclusion, the inland forests of Viet Nam are in rather poor condition today for a number of reasons. Shifting slash-and-burn agriculture continues to be the nation's most serious forestry problem. The annually intensifying demand for fuel wood by a rapidly growing population, and the need for an ever greater area of cultivated land, are further serious threats to the integrity of this important renewable resource. The massive war damage to the inland forest—from which it will take several decades of more or less intensive efforts to recover—thus adds a substantial burden.

Coastal mangrove habitat

The mangrove habitat of Viet Nam covers above 400 000 ha (not including rear mangrove), more than three-quarters of it in South Viet Nam. In contrast to inland habitats, this extraordinarily productive estuarine habitat supports a relatively restricted biota. The plant species have in common the ability to become established and survive in a mucky soil which is periodically inundated with salt water. The dominant vegetation consists of several species of small dicotyledonous trees, mostly 3 to 15 m high and primarily in the genera *Rhizophora*, *Avicennia*, *Bruguiera*, and *Sonneratia*; the shrubby palm *Nipa* is also often in evidence. The vegetation in turn is home to a variety of birds, mammals and other animals. This endlessly channel-dissected habitat is also of major importance as the breeding and/or nursery grounds for numerous salt-water and freshwater fish and crustaceans, indeed, serving this function for the majority of Viet Nam's offshore and river fish. The mangrove vegetation serves as well to stabilize the shoreline.

The mangrove habitat is of major regional importance as a source of small timbers for pilings and construction, firewood, charcoal (from *Rhizophora*), thatch (from *Nipa*), tannin (from *Ceriops* and *Rhizophora*), fish, crustaceans, honey and other products.

During the Second Indochina War an estimated 124 000 ha (or 41 per cent) of South Viet Nam's mangrove habitat was utterly destroyed by chemical attack, mostly between 1965 and 1970 [1j]. The anti-plant chemical warfare agents employed left this vast area virtually lifeless. In addition to the biotic carnage, these attacks permitted serious erosion to occur, both sheet erosion and shoreline erosion. There was some concern among the international scientific community in the early 1970s that biotic recovery would take more than a century.

Examination of the attacked mangrove areas in 1980 (i.e., a full decade or more after their annihilation) revealed that some scattered patches of between perhaps 5 and 50 ha in size have to date remained barren of vegetation. In the aggregate these bare patches amount to perhaps 5 to 10 per cent of the zone of original destruction. The reason these patches have thus far remained bare is not altogether certain, although in at least some instances it may be the result of a modestly depressed elevation. Attempted replantings in these bare patches have proved unsuccessful except where the drainage has been improved by ditching, and the patches have become naturally revegetated or at least amenable to planting.

A few small areas adjacent to undamaged *Rhizophora* stands (by far the most important of Viet Nam's mangrove species) have during the post-destruction decade become naturally revegetated with *Rhizophora.* Such natural regeneration appears to have occurred in about 1 per cent of the destroyed zone. After the deactivation of unexploded munitions and the removal of existing vegetation a further 10 per cent of the destroyed area has now been replanted with *Rhizophora*. Present plans are for several thousand hectares per year to be planted for several more years. *Rhizophora* trees are ready for fuel wood harvest at an age of 30 to 40 years, at which time one tree yields 0.5 m^3 of wood that can be converted to about 90 kg of top quality charcoal. A considerable scattering of *Nipa fruticans* has also been planted along channels in Minh Hai province as has a modest amount of *Cyperus* (two species) for use in basketry, the palm and rushes together certainly amounting to less than 1 000 ha.

Some 5 000 ha of destroyed mangrove habitat (about 4 per cent of it) has in recent years been converted to rice, and another few thousand hectares to other food crops.

The remaining 93 000 ha or so of the originally destroyed mangrove habitat (i.e., about 75 per cent of it) became occupied by a variety of low-growing and locally undesirable plant species within a few years of being denuded. It is assumed that it will take one or more decades before the present vegetation over this large area begins to give way to any considerable extent to the desirable *Rhizophora* species, and even longer in the contiguously large destroyed areas (unless, of course, expensive artificial regeneration is resorted to).

Inshore ocean fishing (i.e., out no further than 12 to 15 km) off the destroyed mangrove areas has during the past decade reportedly continued to decline. Indeed, the recent overall decline in Viet Nam's marine fishery is attributed in part to the loss of mangrove habitat. Clams disappeared in the destroyed mangrove areas and have returned only—and in reduced numbers—in those areas in which *Avicennia* or *Rhizophora* has become established.

With about one-third of it literally destroyed, the mangrove habitat was the ecological system in Viet Nam most seriously affected by the Second Indochina War. Moreover, subsequent conversion to agriculture and other uses can be expected to more or less permanently reduce Viet Nam's mangrove habitat by perhaps 10 per cent. The question thus arises to what extent such long-term shrinkage will lead to species extinctions. It is known that the number of species within any particular taxon that an isolated habitat can support is related to its area. If a habitat is reduced in size, as was the case with Viet Nam's mangroves, the resulting excess of species will in due course die out.

Pre-war data on species numbers are not at hand for Viet Nam's mangrove habitat. Literature on comparable habitats in parts of the East Indies [49a] and the Galapagos islands [49b] allows us to estimate that a 10 per cent reduction in Viet Nam's mangrove habitat is likely in time to lead to 4 per cent and 3 per cent reductions in the number of bird and plant species, respectively, that can be supported. If any of the species lost from the area are endemic ones they will, of course, be lost to nature.

In conclusion, roughly one-third of Viet Nam's total mangrove habitat has been lost for perhaps half a century or more and is thus unavailable throughout this protracted period for exploitation for charcoal and other products so crucial to a growing population and a struggling economy.

Fisheries

The marine and inland fishery resources of Viet Nam provide an important source of protein-rich food [5i]. Perhaps 75 per cent of the catch is consumed as fresh fish, 5 per cent as dried fish and the remaining 20 per cent in the form of fish sauce. Viet Nam has close to 350 000 fishermen, of whom 70 per cent are engaged in ocean fishing.

The annual marine catch increased for a brief period following the Second Indochina War, owing to an upsurge of fishing activity (table 11.5). It has, however, been declining in recent years, a situation partly attributed to wartime damage to the mangrove breeding and nursery grounds. Significant decreases in the number and variety of planktonic and benthic forms as well as in fish eggs had been noted in the destroyed mangrove areas in the early 1970s, and such declines were associated with declines in offshore fin-fish and shell-fish numbers [52]. The decline in Viet Nam's marine fishery is also partly due to a paucity of equipment and to reductions in the fishing fleet. These reductions stem on the one hand from a lack of spare parts and fuel, and on the other from the loss of boats taken along by emigrants (the so-called boat people).

Viet Nam is now actively encouraging the establishment of fish ponds [53] and otherwise attempting to develop inland fishing. Indeed, some 100 000 ha of inland waters are being given over to intensive pisciculture (table 11.1). A considerable number of the bomb craters located in farming areas that penetrate the water table have been converted to fish ponds. An annual fish yield of 2 to 3 t/ha is expected from intensive

Table 11.5. The marine fisheries of Viet Nam[a]

Year	Catch[b] (1 000 tonnes)	Catch per capita[c] (kg/cap)	Fish sauce production[b] (million litres)	Fish sauce per capita[c] (litres/cap)
1960	550[d]	18[e]		
1975	550	11	83	1.7
1976	610	12	99	2.0
1977	590	12	120	2.4
1978	520	10	115	2.2
1979	490	9	91	1.7

[a] The coastline is 3 260 km long (North Viet Nam 970 km; South Viet Nam 2 290 km) and the fishing fleet consisted of 47 000 boats in 1977, two-thirds of them motorized [5j]. In addition to the marine fishery, inland fishing adds perhaps 15 to 20 per cent to the annual catch [5k, 18a].
[b] 1960 datum estimated from references [7b, 50, 51a]; 1975–79 data from references [3e, 14b]. The catch values are in fresh (live) weight.
[c] Based on population figures from table 11.2.
[d] North Viet Nam 200 000 tonnes; South Viet Nam 350 000 tonnes.
[e] South Viet Nam exported of the order of 100 000 tonnes/yr during this period [5j] so that ocean fish consumption in Viet Nam in 1960 averaged perhaps 15 kg/cap (North Viet Nam 13 kg/cap; South Viet Nam 18 kg/cap).

freshwater pisciculture. Moreover, some current research efforts in the Mekong Delta are aimed at developing a shrimp culture industry as one means of utilizing portions of the reclaimed mangrove habitat, and a similar effort is being begun for crab culture.

In summary, Viet Nam's important marine fishery is in a continuing post-war decline of several years' standing, one reason for which appears to be linked to the major wartime disruption of the mangrove habitat.

Endangered species

Several decades of war culminating in the Second Indochina War did much to disrupt the varied tropical habitats of Viet Nam and the once plentiful wildlife that depended upon them. The current status of a number of rare and endangered species is described in detail elsewhere [54].

A number of mammals, birds and plants are threatened with extinction as a result, at least in part, of wartime disruption. The scientific community of Viet Nam is highly sensitive to the plight of the country's endangered species and to conservation issues in general. However, equipment, fuel and other necessities are simply not available for systematic on-site investigations of natural habitats and the wildlife which they support, nor do they suffice for major rehabilitation programmes. Moreover, the plethora of unexploded munitions that remains hidden in the wilds makes field operations highly dangerous.

Current national priorities serve to channel most of the efforts of the scientific community into improving agricultural productivity (of both food and industrial crops), or into utilizing natural resources for domestic consumption and export. Some of the war-damaged natural habitats are not, therefore, being permitted to revert to nature, but are instead being converted to agriculture. Reduction in the size of a natural habitat, or its fragmentation, as noted earlier, results in a reduction in the number of species that an area can support. It is thus inevitable that a number of species of plants and animals will as a result slip into oblivion, some to be noticed and others not. The hill tribespeople pose another continuing conservation problem owing to their unwillingness to abide by the laws which would protect wildlife and natural habitats.

At present, Viet Nam has one major nature reserve, the 25 000-ha Cuc Phuong National Park, which was established in 1962 in a mountainous primaeval forest area about 100 km southwest of Hanoi. This park is rich in species of plants and animals and is scenically majestic [55]. It is possible that a second such park will be established as a refuge for such native and at least locally endangered species as the douc langur, banteng, wild water buffalo, leopard, cloud leopard, hog deer, and Edwards's and imperial pheasants.

Agriculture

The Second Indochina War brought about agricultural disruption in a variety of direct and indirect ways, both intentionally and unintentionally [2e, 56, 57].

In North Viet Nam, some fraction of the US bombing and shelling cratered cultivated lands and destroyed irrigation systems. Moreover, the supporting infrastructure was to a large extent destroyed. Much livestock was killed (including some 24 000 water buffaloes), of the order of 1 600 water conservancy works were damaged, dikes were breached in more than 1 000 places, and 48 agricultural schools and research stations were damaged [9b, 23a].

In South Viet Nam, the USA carried out a routine military policy of systematic large-scale crop destruction [58]. Chemical crop destruction from the air made up the greatest proportion of the major US resource denial programme. Significant fractions of this US programme of so-called economic warfare were also carried out by bombing and shelling as well as by a variety of ground operations. Chemical crop destruction alone is estimated to have affected 400 000 ha of agricultural lands in South Viet Nam, resulting in the immediate destruction of more than 300 000 tonnes of food [2f]. Aside from the programme of economic warfare there was an enormous amount of casual agricultural destruction.

In addition, South Viet Nam experienced a wartime dearth of available manpower (owing to the high proportion of persons in military service, to military fatalities and other casualties and to the displacement of farmers to urban areas), widespread deterioration of farm land (owing to abandonment after the relentless rural bombing), and widespread destruction of livestock, including perhaps 900 000 water buffaloes [9c, 23b].

Some measure of the military disruption of agriculture in South Viet Nam can be gleaned from rice surplus and deficit figures [56a]. Before the Second Indochina War, South Viet Nam's average annual export of processed (milled) rice was 200 000 tonnes (1957–61), which represents the yield from almost 150 000 ha. During the war years, the average import of milled rice to South Viet Nam was 600 000 t/yr [56a]. In South Vietnamese terms this represents the yield from just over 400 000 ha. Military disruption can thus be estimated to have taken out of production the equivalent of about 600 000 ha of farm land during the war years, or roughly one-fifth of South Viet Nam's total.

Table 11.6. Gross production indices for Viet Nam[a]

Year	Population[b]	Food crop production[c]	Industrial crop production[c]	Livestock production[c]	Overall agricultural production[c]	Industrial production (non-agricultural)[d]
1975	100	100	100	100	100	100
1976	103	118	103	101	110	113
1977	106	108	94	108	105	124
1978	108	108	108	94	105	131
1979	110	120	104	102	112	125

[a] The agricultural and industrial indices are all based on constant prices.
[b] Based on population values from table 11.2.
[c] From reference [3g].
[d] From reference [3h].

The immediate post-war efforts of the people of all Viet Nam made for a 10 per cent increase in overall agricultural output and an 18 per cent increase in food crop production by 1976 (table 11.6). However, agricultural advances since 1976 have been extraordinarily slow and in some respects non-existent (table 11.7). The extent of cereal land sown has increased a little each year, but the nation-wide yield per unit area has remained essentially constant since before the war. Barely self-sufficient in cereals (by low standards) before the war, Viet Nam has had to rely on food imports since the war in order to stave off famine. As it is, widespread signs of malnutrition have been reported [59].

Viet Nam has more than a million new mouths to feed each year (table 11.2). The area sown to cereals in Viet Nam—0.13 ha/cap (table 11.7)—

Table 11.7. Cereal (grain) production in North and South Viet Nam[a]

Year	Area sown[b] (million ha)	Yield (unprocessed)[c] (million tonnes)	Yield per unit area (unprocessed) tonnes/ha	Area sown per capita[d] (ha/cap)	Production per capita (processed)[e] (kg/cap)	Imports (processed)[f] (million tonnes)
North Viet Nam						
1960	2.0	3.1	1.5	0.13	128	
1976	2.8	6.2	2.2	0.11	166	
1979	3.1	6.0	1.9	0.12	152	
South Viet Nam						
1960	2.5	5.4	2.2	0.18	257	
1976	3.4	7.3	2.2	0.14	200	
1979	3.8	7.7	2.0	0.14	195	
All Viet Nam						
1960	4.5	8.5	1.9	0.15	189	[g]
1975	5.6	11.6	2.1	0.12	162	1.0
1976	6.2	13.5	2.2	0.13	183	0.7
1977	6.6	12.9	2.0	0.13	170	1.3
1978	6.8	12.9	1.9	0.13	167	1.4
1979	6.9	13.7	2.0	0.13	174	1.6
1980		14.0			174	

[a] Rice accounted for over 90 per cent of cereal area and production in 1960, decreasing to about 80 per cent in 1979.
[b] 1960 data from reference [7a]; 1975–79 data from references [3i, 3j].
[c] 1960 data from reference [7a]; 1975–79 data from references [3j, 3k]; 1980 datum from reference [74a]. The data are presented in terms of unprocessed rice equivalent. 1.43 kg of maize counts as 1 kg of rice.
[d] Based on population figures from table 11.2, using appropriate growth rates for North and South Viet Nam.
[e] Based on population figures from table 11.2 and a conversion factor of 0.667 from unprocessed to processed (milled) rice. A minimal annual amount for nutrition is considered to be about 187 kg/cap. Somewhat more (10 per cent?) is needed to account for seed requirements and loss in storage.
[f] From references [3m, 14d].
[g] South Viet Nam exported 0.4 million tonnes of processed rice in 1960 (and an annual average of 0.2 million tonnes during the 4 years 1957–1961) [56a].

is rather low by tropical standards (average 0.30 ha/cap) [2g], but its expansion since the end of the war has more than matched the pace of population expansion. However, with an unimproved overall yield per unit area, the production per capita remains inadequate.

The essentially unchanging national unit area yield figures can be attributed to a host of factors. That wartime disruption of the rural areas has been a major contributor to this calamity is suggested, among other things, by the improvement in pre- to post-war yields in more lightly damaged North Viet Nam and the lack of such improvement in the more heavily damaged South Viet Nam (table 11.7). In addition the agricultural expansion associated with the new frontier or new economic zone programme has been to a considerable extent into relatively unsuited land. These have often been war-destroyed forest lands substantially better suited to growing trees than farm crops, especially in the absence of increasingly expensive fertilizers.

The inauspicious agricultural situation can be further attributed to the large-scale loss of draught animals (water buffaloes) and a lack of fuel or spare parts for the few existing farm tractors. The pre-war number of water buffaloes per unit area of sown land has not been re-attained during the post-war years, and post-war fertilizer and pesticide inputs per unit area remain low and relatively unchanging (table 11.8). The water conservancy and associated irrigation systems that were disrupted during the war have not all been restored as yet. High-yield rice varieties developed in recent years cannot fulfil their genetic potential without a carefully regulated and fully adequate water regime as well as high levels of fertilizer and pesticide applications.

Some fraction of today's agricultural work-force has inadequate agricultural experience or training owing to wartime military service or wartime displacement to urban centres, and some fraction of the potential agricultural work force is in military service at this time.

Although North Viet Nam has been able to increase its pre-war per capita cereal productivity (table 11.7), it has nevertheless maintained its traditional inability to be agriculturally self-sufficient. South Viet Nam, whose agriculture was far more seriously disrupted by the Second Indochina War, is now essentially self-sufficient at an austere level, but has not as yet regained its comfortable pre-war surplus. To some extent this appears to be the result of a reluctance on the part of South Vietnamese farmers to form agricultural collectives or to produce a surplus for the North without being able to receive compensation in the form of consumer goods.

United Viet Nam hopes to come to grips with its agricultural shortfalls by a multiplicity of approaches, as enunciated in its recent five-year plan, which gave agricultural development top priority [60–62]. The one thing abundantly clear is that a continued dependence by Viet Nam on staple food imports is an unacceptable situation in the face of such modest present potential for exports and in the light of growing world-wide food shortages. Moreover, with a relatively modest endowment in the form of minerals, Viet Nam must learn to lean far more heavily upon industrial crops, both as a source of raw materials to supply its indigenous industry and as a major contributor to exports.

Rubber

Before the Second Indochina War rubber was of great economic importance in South Viet Nam [2h, 63], accounting for about 60 per cent of the total value of exports and employing some 100 000 workers. The rubber

Table 11.8. Selected contributors to agricultural productivity in Viet Nam

Year	Water buffaloes[a] (million)	Water buffaloes per unit area[b] (no./10 ha)	Chemical fertilizer production[c] (million tonnes)	Chemical fertilizer imports[d] (million tonnes)	Chemical fertilizer per unit area[e] (kg/ha)	Pesticide production[c] (million tonnes)	Pesticides per unit area[b] (kg/ha)
1960	2.25	5.0					
1975	2.19	3.9	0.45	0.41	150	7.2	1.3
1976	2.24	3.6	0.46	0.57	170	16.4	2.6
1977	2.29	3.5	0.52	0.64	180	19.0	2.9
1978	2.32	3.4	0.61	0.64	180	19.7	2.9
1979	2.29	3.3	0.26	0.41	100	18.4	2.7

[a] 1960 datum combined from 1.45 million for North Viet Nam [7c] plus 0.80 million for South Viet Nam [51b]; 1975–79 data from reference [3n]. Viet Nam also has in use an estimated 24 000 farm tractors [6b].

[b] Based on the areas of cereal land sown from table 11.7.

[c] From references [3e, 14b].

[d] From references [3m, 14d].

[e] Based on the areas of cereal land sown from table 11.7. A substantial although unknown amount of organic fertilizer (originating from livestock and human excrement, etc.) is also used.

plantations were located in areas subject to intense military activity during the War and as a result suffered considerable damage from indiscriminate (wide-area) bombing, shelling and chemical attack. Processing facilities were also destroyed in many instances. About 40 per cent of South Viet Nam's plantation trees were destroyed during the war and overall production was reduced by about 70 per cent (table 11.9).

The war-reduced land area devoted to rubber plantations has hardly been expanded since the war ended, although there are plans to match at least the pre-war extent as economic conditions permit. Existing plantations have been in part rehabilitated through removal of unexploded munitions (so far resulting in some 400 casualties), replanting, and so forth. The yield per unit area is beginning to approach pre-war levels. Rubber export (in the form of latex) has regained roughly half the pre-war level (table 11.9).

In short, Viet Nam's important rubber industry was damaged substantially by the Second Indochina War and is recovering at a very slow pace. Indeed, the re-attainment of pre-war production (and export) levels seems still to be many years off.

Table 11.9. Rubber data for Viet Nam[a]

Year	Area[b] (million ha)	Yield[c] (thousand tonnes)	Yield per unit area (kg/ha)	Exports[d] (thousand tonnes)
1960	135	78	580	70
1975	81	24	300	7
1976	82	24	300	28
1977	81	42	520	36
1978	81	46	570	25
1979	83	43	520	33

[a] Virtually all rubber production is in South Viet Nam.
[b] 1960 datum from reference [2i]; 1975, 1976, 1978 and 1979 data from reference [3o]; 1977 datum interpolated.
[c] 1960 datum from reference [7a]; 1975–79 data from reference [3o]. Yield is expressed in terms of dried latex.
[d] 1960 datum from reference [56b]; 1975–79 data from references [3f, 14c].

IV. The lesson of Viet Nam

It is a truism that warfare is detrimental to the environment. However, the Second Indochina War ushered in a new level of anti-environmental ferocity. Faced with a dispersed and elusive enemy in South Viet Nam, the USA sought to deny this foe both sanctuary and freedom of movement and a local civilian economy from which to help to derive sustenance. The US strategy that was meant to achieve these goals required the profligate expenditure of munitions, both conventional and unconventional, directed in large measure against the fields and forests of South Viet Nam. The emphasis here has been on the impact of these actions on the ecology and economic development of Viet Nam, and only cursory treatment has been given to the more strictly social sequelae of the war.

The Second Indochina War has made it clear that the impact of environmental warfare spills over the spatial and temporal bounds of the attacks and, moreover, that the brunt of such attacks is borne by the civilian population. Indeed, it has been shown that it is the civilian sector that continues to bear this burden long after hostilities have ended. Despite the massive level of disruption of Viet Nam's natural resources, the military objectives were in the end not achieved. Their realization would have required an intensification of the assault to truly ecocidal and thus genocidal proportions.

Presumably as a direct outcome of the Second Indochina War, at least some fraction of the international community has come to recognize the unacceptability of military assaults on the environment as a strategy of war. For example, 33 or more nations have (as of the end of 1981) ratified the 1977 Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques. This Convention, which entered into force in 1978, prohibits the parties from engaging in 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 [64a, 2j]. Similarly, 18 nations have (as of the end of 1981) ratified the 1977 Protocol (I) Additional to the Geneva Convention of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts. This Protocol, which also entered into force in 1978, *inter alia* limits attacks on agricultural lands, prohibits starvation as a method of warfare, and restricts means of war that would damage the natural environment [2j, 64b].

As much as a decade has now elapsed since the time of the major anti-environmental assaults against Viet Nam. Their effects are disappearing agonizingly slowly. Indeed, Viet Nam's industrial production is recovering more rapidly than its far more directly land-based agricultural productivity (table 11.6), a phenomenon that has also been observed among European countries that had been embroiled in World War II [2k].

Natural ecological recovery of a disrupted habitat is an inevitable phenomenon, albeit a slow one. In many instances such natural recovery can be aided by human action. The expertise and financial resources required, however, are in short supply in a war-ravaged and otherwise impoverished nation such as Viet Nam. Viet Nam is thus, for the time being, dependent upon foreign assistance, a need that has been recognized by the United Nations [5m, 65–67] and at least tacitly acknowledged by Viet Nam itself in that its national five-year plan of 1976–80 was heavily dependent upon such aid [68a, 69a].

In the post-war period Viet Nam has received aid from at least 11 organizations of the United Nations system, from 17 or more nations, and from various private agencies located around the world. Total annual aid in recent years has been of the order of $1 500 million, placing it among the several highest aid recipients in the world. One might add that the poor condition in which Viet Nam finds itself today despite the relatively high level of foreign assistance it is receiving emphasizes the enormity of its war damage. It could also be argued that the situation might improve if fewer resources were allocated to the military sector. Indeed, Viet Nam's complement of armed forces of 600 000 [17a] or more [70] is extraordinarily large by various standards [2m].

Viet Nam's introduction into the age of technology has been a brutal one. It can only be hoped that the future will be kinder to it than the recent past and that man and nature will co-operate to restore this region to its former productive beauty as rapidly as possible.

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Part III. Latin America: a regional study

Chapter 12. Militarization and arms control in Latin America

12. Militarization and arms control in Latin America

Square-bracketed numbers, thus [1], *refer to the list of references on page* 423. *Data for which no reference is given are based on SIPRI worksheets. Military expenditure figures are in constant 1978 prices, unless otherwise indicated, and are based on figures published in the* SIPRI Yearbooks.

I. Definitions

The term 'Latin America' is most commonly applied to the group of nations of the Western Hemisphere that were former colonies of Spain, Portugal and France. By extension, the term is used to denote all territory in the Western Hemisphere south of the United States, including the present possessions of France, the Netherlands, the United Kingdom and the United States.

In scientific literature Latin America is often divided into the following sub-regions: Mexico and Central America; Cuba and other Caribbean countries; the Andean states (Venezuela, Colombia, Ecuador, Peru, Bolivia and Chile); the River Plate Basin (Argentina, Paraguay and Uruguay); and Brazil. However, for the purposes of this chapter, a simpler division is made: the sub-region of Central America and the Caribbean (including Mexico) and that of South America.

The term 'militarization' will be used to denote a steady growth in the military potential of states. Such growth is usually accompanied by an increasing role for military institutions both in national affairs, including the economic, social and political spheres, and in international affairs. Armed forces have traditionally been involved in government in Latin America, and military coups d'état have been frequently resorted to as a mechanism for political change in the area. The growth of military potential will be measured by such indicators as overall military spending, military effectives and military hardware, from the early 1960s to the early 1980s.

Most countries selected for study in this chapter are situated in conflict areas. The state of militarization in these states is examined in conjunction with ongoing or potential conflicts. Only inter-state conflicts which derive from claims to political leadership, territorial disputes or controversies over natural resources and which have an impact on the political situation in the region are described here. However, reference is also made to internal conflicts, when relevant.

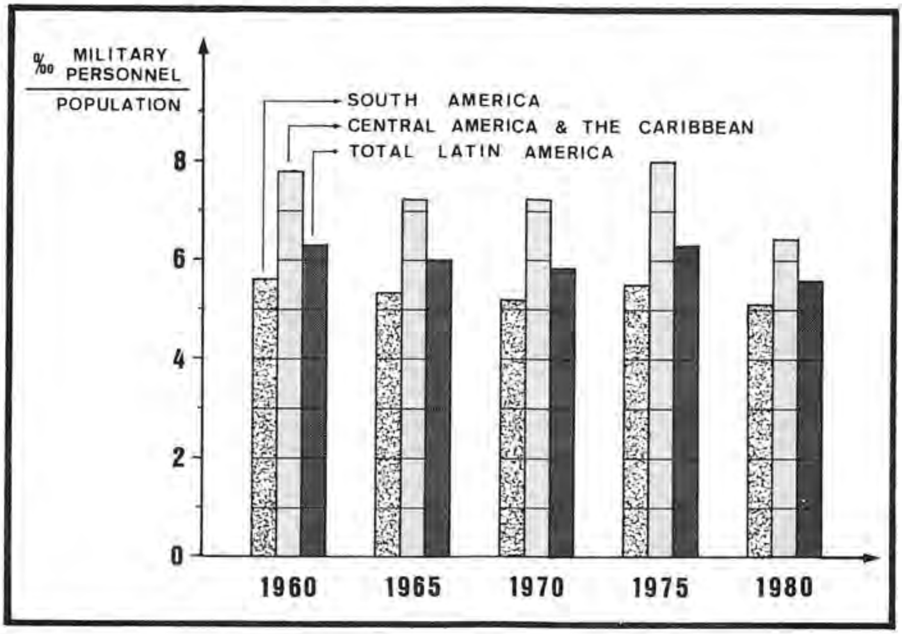
The term 'arms control' is used to denote measures intended to freeze, limit or abolish certain categories of weapons, both nuclear and conventional, as well as measures meant to build up confidence among states and thereby produce an international climate conducive to the control of armaments.

II. Latin America: a general overview

The present population of Latin America is approaching 370 million and is expected to double within the next 25 years; for comparison, the population of the USA may take 87 years to double. The rate of demographic growth in Latin America is now close to 3 per cent [1]—higher than in any other major region of the world—and is still increasing, while the growth rate of the gross domestic product (GDP) is decreasing [2a]. This development has not affected military spending in the area, which is still accorded high priority in state budgets. For instance, in Brazil, the largest country in the region, twice as much was spent in 1979 on defence as on education, seven times as much as on medical services, and twenty times as much as on housing.

The strength of military forces has grown roughly in line with the growth of the population (see figure 12.1), and stocks of arms have accumulated. In the past 20 years the imports of major weapons by Latin American countries have grown by around 8 per cent a year, while the

Figure 12.1. Military forces in Latin America, 1960–80



imports of all goods and services have increased only by around 6 per cent a year. Imported weapon systems are becoming ever more sophisticated: since the mid-1960s Latin American countries have acquired supersonic jet fighters, submarines, guided-missile frigates and medium tanks. The need felt by some off-shore oil-producing countries in Latin America to protect their interests, as well as the expected overall extension of the internationally recognized exclusive maritime economic zone, have increased the demand for modern warships and missiles.

Certain Latin American countries have simultaneously developed capabilities to manufacture their own weapons. At the beginning of the 1960s, only two countries had a significant potential to produce major weapons;[1] by 1981, as many as eight countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru and Venezuela) had become producers of major weapons. A similar trend has developed for small weapons:[2] two decades ago only four countries (Argentina, Brazil, the Dominican Republic and Mexico) were able to produce such weapons; now more than 10 countries can do so. Thus, indigenous production already meets a large part of the weapon requirements of Latin America. Some of these countries even export weapons; Brazil has become the tenth largest arms exporter in the world and the first among Third World exporters of major weapons.

Militarization has often been justified by national security considerations, but in most cases the causes of militarization in Latin America lie in the social conditions prevailing in individual countries. The turning-point was the 1959 Cuban Revolution, which engendered fears of similar upheavals elsewhere. The 1961 Bay of Pigs intervention, carried out by expeditionary forces of Cuban exiles and sponsored by the United States, led to a massive programme of Cuban armament with Soviet military assistance. In turn, the 1962 Cuban missile crisis provided additional justification for increased arms build-ups in Latin American countries with US assistance. At the same time, a few dormant inter-state conflicts flared up, some leading to armed clashes.

The USA and Latin America

Latin America has long figured as a major object of US political projection in the world. For years, the United States has been instrumental in shaping the politics of Latin American countries, but in recent times some of these countries have started to emerge in the world arena as independent actors actively pursuing their own interests [3]. In fact, it

[1] 'Major weapons' referred to here are aircraft, armoured vehicles, missiles and warships.
[2] 'Small weapons' refer here to pistols, revolvers, rifles/carbines, sub-machine-guns, machine-guns, recoilless cannons, field guns, howitzers, anti-tank guns, anti-aircraft guns, mortars, grenades, grenade launchers, ammunition, mines, torpedoes and combat aids.

was the Cuban Revolution that started the gradual process of political emancipation of Latin American states from US tutelage.

The USA also has a vital economic stake in Latin America, which accounts for 77 per cent of all US investment in the Third World. Latin America is the third largest market for US products, after Europe and Canada. Further, the USA imports a number of critical raw minerals from Latin America, such as antimony, barium, bauxite, bismuth, colombium, gypsum, lead, mercury, quartz, rhenium, selenium, silver, strontium, vanadium and zinc [4]. In recent years Latin American petroleum has constituted about 40 per cent of the total amount of petroleum imported by the USA. Since Mexico, Guatemala and Venezuela, taken together, have the largest potential for hydrocarbon energy development in the world, US oil imports from this area are likely to increase. (The estimated reserves for Mexico alone are believed to equal those of Saudi Arabia.)

The USA also has security interests in the region, specifically in the Caribbean's sea lanes, through which pass all naval and commercial vessels using the Panama Canal, a significant proportion of shipping bound to or from the South Atlantic, and much of the United States' imported oil. Because of the region's location, the USA has an interest in maintaining military bases there.

In regard to supplies of weapons to the area, the USA lost its monopolistic position in the 1960s, but in 1977 it was still an important supplier, second only to the Soviet Union [5]. During 1978–80, as a result of the US policy of refusal to provide arms to countries accused of violating human rights, US weapon exports to the region fell drastically. Following the change of US Administration in 1981, weapon exports are rising again. In particular, Latin American countries are now acquiring modern F-5 (Mexico) and F-16 (Venezuela) fighter planes, as well as helicopters and other US military equipment. The present US government considers that the arms trade policy of the previous Administration was erroneous because it reduced the role of the USA in Latin America and facilitated Soviet influence in the region.

The USSR and Latin America

Latin America was of low political interest to the Soviet Union for a long time. However, after the 1959 Cuban Revolution, the USSR became active in the region. This activity eventually led to a confrontation with the USA in the 1962 missile crisis. Since then, certain rules of behaviour in the region seem to have been established between these two powers, implying no US military intervention in Cuba and no Soviet deployment of nuclear weapons there. Nevertheless, Cuba has remained a point of friction between the USA and the USSR, and allegations of breaches of the rules of behaviour have been numerous.

Soviet economic interest in Latin America lies primarily in the import of food and certain manufactured products. The balance of trade has been highly favourable to the Latin American countries. In 1979 Argentina and Brazil accounted for 85 per cent of all Soviet imports from Latin America (excluding Cuba), and in that year Argentina had a surplus of $500 million, while Brazil had one of $227 million. (The surplus accumulated by Argentina over the period 1966–80 was $3.95 billion [6, 7].) The Soviet Union has been providing technology, in particular in the field of energy, often on very favourable terms. Thus, the economic stakes of the USSR in the region are becoming significant; also, the Soviet Union represents an important market for Latin America. Both sides have demonstrated that they are free of ideological prejudices when it comes to trade.

The Soviet Union has become the largest arms supplier to Cuba, Peru and, indirectly, to Nicaragua, the only recipients of Soviet arms in Latin America. While in the period 1966–75 the USSR was the third largest exporter of weapons to Latin America (after the USA and France), during 1974–78 it moved up to first place with a volume of exports twice as high as that of the USA (the next largest exporter) [5, 8]. Soviet supplies include modern MiG-23 and Su-22 fighter planes, helicopters, as well as missiles, frigates, submarines and tanks.

III. Central America and the Caribbean

The level of militarization of this sub-region, which was rather low until 1959, rose dramatically in the wake of the Cuban Revolution. From 1960 to 1970 military spending in Central America and the Caribbean increased by 72 per cent and by 122 per cent from 1970 to 1980. The strength of the armed forces almost tripled in the past two decades. For most countries of the sub-region the weapons possessed are suitable mainly for police and counter-insurgency purposes. Since none of them is a significant arms producer, practically all the weapons in the sub-region are imported, mainly from the USSR, the USA and Israel.

Cuba

From the military point of view, this sub-region presents a heterogenous picture: from Costa Rica, which has no regular army,[3] to Cuba, which

[3] There have been no military forces in Costa Rica since 1949. Article 12 of the Constitution states that "the army is prohibited as a permanent institution".

has modern and sophisticated war machinery. Cuba is now the most militarized country in Latin America, as measured by the ratio of population under arms and military spending per capita. The strength of Cuban armed forces is second only to that of Brazil, while Cuban military spending is third after that of Brazil and Argentina. Mexico, the most populated country in the sub-region, with some 70 million inhabitants, has armed forces only half as large as those of Cuba, with a population of about 10 million (see table 12.1).

Table 12.1. Brazil, Mexico and Cuba: a comparison, 1960–80

Country	Year	Population (million)	Armed forces (thousand)	Military expenditure ($ mn, at 1978 prices and 1978 exchange-rates)
Brazil	1960	70.7	222.0	820.0
	1970	92.5	234.0	1 596.0
	1980	120.0	281.0	1 907.0
Mexico	1960	34.9	55.0	180.0
	1970	50.6	68.5	385.0
	1980	69.5	110.0	563.0
Cuba	1960	6.9	52.0	222.0[a]
	1970	8.5	194.0	367.0
	1980	9.9	215.0	1 065.0[b]

[a] 1961.
[b] 1979.

Furthermore, Cuba is the only country not only in Latin America but also in the whole Third World to maintain a significant military presence abroad. In 1981 this presence was estimated at some 40 000 people. Some 19 000 Cuban military personnel and several thousand civilian technicians are stationed in Angola. The next largest Cuban force abroad, about 16 500, is in Ethiopia. Reportedly, other Cuban contingents range from a few thousand advisers in Nicaragua [9] (denied by the Nicaraguan government) to a few hundred military personnel in Algeria.

The USSR is Cuba's principal supplier of weapons and logistic support. Total Soviet assistance to Cuba (including economic assistance) is estimated at $3 billion annually [9], out of which military aid amounts to at least half. Most of this is grant aid. Cuba has paid for some of the weapons obtained from other Socialist countries, such as Czechoslovakia [10].

According to US press reports, the Soviet Union has sent more arms to Cuba in 1981 than in any other year since the missile crisis. The volume of weapon deliveries through September 1981 is estimated at 50 000 tonnes, as compared to 21 000 tonnes in all of 1980. The weapons supplied include surface-to-air missiles, tanks (T-62), amphibious armoured infantry combat vehicles, armoured personnel carriers, anti-tank guns, anti-aircraft artillery and coastal minesweepers. The increased weapon imports may reflect Cuba's renewed concern about its security in view of the recently reiterated threats of military action on the part of the USA. However, some of these weapons may have been destined for the Soviet troops in Cuba [11]. Cuba is obligated under an agreement not to transfer arms received from the USSR to other states [12].

The Soviet Union maintains in Cuba a brigade of 2 600 men, consisting of three battalions of infantry and one of tanks. The equipment includes 40 tanks and 60 armoured personnel carriers. In addition, the naval facility at Cienfuegos is used by visiting Soviet submarines and surface warships, while the airbase at San Antonio de los Baños is used by Soviet reconnaissance aircraft [13, 14].

The United States holds a military base at Guantanamo Bay in Cuba under a lease in perpetuity, and has so far rejected demands by the Cuban government that the base be given up. US troops there consist of permanently stationed marines, the estimated number of which varies from a few hundred to some 3 000 [15, 16]. The base has a naval group performing signal intelligence functions and a naval air station facility, but its strategic importance has so far been rather low; it has no significant major weapons and is used mainly for training and manoeuvres. Cuba complained that from 1959 to 1979 the USA, using the Guantanamo base, violated Cuban airspace more than 6 000 times and trespassed into Cuban territorial waters 1 300 times [17].

Cuba justifies its armament programme by what it perceives to be a constant threat of US invasion. In 1981 it even accused the USA of waging bacteriological warfare against the Cuban population [18]. In addition, the Cuban government feels that it has an internationalist duty to help liberation movements all over the world, as well as to defend the security of certain states.

US animosity towards Cuba derives primarily from a perceived threat to US interests abroad due to Cuban assistance to anti-US movements in Latin America and elsewhere. In particular, the US government has accused Cuba of transferring weapons to the opposition forces and of actively participating in guerrilla operations in El Salvador. Moreover, Soviet military presence and support to the Cuban government constitute a constant irritant to the USA.

Mexico

Mexico is the only other country in the sub-region to possess such sophisticated weapons as supersonic aircraft, missiles and warships. In 1981

Mexican arms .imports included F-5 fighter aircraft from the USA, corvettes and fast patrol vessels from Spain, turbo-prop aircraft trainers from Switzerland, and helicopters and armoured vehicles from France. Mexico has also made quick progress in the development of its indigenous arms industry, specifically in the field of armoured vehicles, fast patrol boats and heavy machine-guns. The joint army and air force budget increased by 55 per cent in 1980, but overall defence spending has been rather low by Latin American standards [19–21].

The expansion and modernization of the armed forces of Mexico may be motivated, among other reasons, by the need to protect its oil resources. In the process of militarization, the Mexican military establishment is gaining political importance.

The general situation in Central America

US and Cuban policies have had an important impact on the overall situation in Central America and have, to a great extent, influenced political and social developments within the states of the sub-region. However, arms supplied by the USA with the aim of reinforcing the governments in power have failed to prevent the collapse of some of them. The popular insurrections seeking social and political change have created a propitious climate for interference by other states as well. Mexico and Venezuela, the leading regional powers, have more or less openly supported one or another party to internal conflicts, favouring different political solutions.

Until the mid-1970s the armed forces of Guatemala, Honduras, El Salvador and Nicaragua were equipped primarily with surplus US equipment, delivered under a military assistance programme, consisting of armoured personnel vehicles, rifles, machine-guns, howitzers, mortars and ammunition [22]. In 1975 Israel became a major supplier of armaments to these countries by providing STOL (short take-off and landing) transport aircraft, fighter-bombers, trainer aircraft, artillery and small weapons such as sub-machine-guns, machine-guns, rifles, rockets, mortars, and so on. The arsenals of these countries also include weapons from FR Germany (rifles), France (light tanks with 75-mm cannons), Brazil (land and maritime patrol aircraft), the United Kingdom (light tanks), and the Soviet Union (helicopters).

The strength of the armed forces in Guatemala, Honduras, El Salvador and Nicaragua has risen significantly during the past two decades and has doubled in the case of Guatemala. Because of the internal upheavals, the ratio of police and paramilitary forces to the armed forces has increased.

The militarization of Central America has been taking place simultaneously with the heightening of the level of internal violence in the countries of this sub-region. These countries are also affected by serious border and territorial disputes, which sometimes escalate to the level of armed conflicts. The main disputes are those between El Salvador and Honduras, Nicaragua and Colombia, Honduras and Nicaragua, and the newly established state of Belize and Guatemala. Furthermore, the problem of the Panama Canal has not yet been completely resolved.

El Salvador and Honduras

In the 1960s a long-standing border dispute between El Salvador and Honduras was aggravated by demographic pressures—El Salvador has 500 inhabitants per square mile, whereas Honduras has only 50—as well as by economic pressures caused by a Honduran law which expropriated Salvadorean farmers possessing land in Honduras. Accusations of mistreatment of Salvadorean immigrants (about 15 per cent of the Honduran population) erupted in a brief but violent war in mid-1969, called the 'football war' because it started in the wake of a football match lost by the Hondurans. Some 2 000 people were killed and 100 000 made homeless; El Salvador's only oil refinery was destroyed, and the conflict led to a paralysis of the Central American Common Market [23]. As a consequence of these events, military spending in El Salvador almost tripled in 1969 as compared to the previous year, while military spending in Honduras doubled during the same period (in constant 1973 prices). Mediation by the Organization of American States (OAS) defused the situation somewhat due to the establishment of a demilitarized zone between the two countries, controlled by Guatemala, Costa Rica and Nicaragua. However, clashes flared up again in 1976, leading to new increases in military expenditures. In 1980 El Salvador and Honduras, plagued by domestic troubles, concluded a peace treaty formally ending 11 years of hostility. The border dispute has still not been settled, but a mechanism has been established to solve it [24, 25].

During the past two years El Salvador and Honduras, together, have received from the USA some 30 armed helicopters, specially adapted for fighting guerrilla forces. Moreover, in 1981 US military aid to El Salvador and Honduras included M-16 and M-14 rifles and recoilless rifles, sidearms, grenade launchers, mortars, patrol boats, trucks, jeeps, spare parts for aircraft and helicopters, as well as military advisers [26–28]. These weapons are now being used exclusively for suppressing the internal opposition. In El Salvador, for example, as many as 35 000 people were killed from October 1979 to the end of 1981 [29]. In 1982 some 1 500 Salvadorean soldiers are scheduled to be trained in the USA.

Nicaragua and Colombia

In December 1979 the new Nicaraguan government proclaimed its right to a 200-mile maritime economic zone and its sovereignty over the keys of Roncador, Quitasueño and Serrano, as well as the islands of San Andrés and Providencia in the Caribbean Sea. It declared null and void the 1928 Barcenas-Esguerra Treaty between Nicaragua and Colombia, as well as non-recognition of the 1972 US–Colombian Treaty, both of which had ensured the sovereignty of Colombia over these keys and islands [30]. Since then, Nicaraguan and Colombian boats have clashed repeatedly in the zone, and the danger of an armed conflict between these two states persists. The underlying reasons for the dispute are both strategic and economic (mainly because of oil resources). Nicaragua has only coastal, lake and river patrol forces of a few hundred men, while the Colombian Navy has 9 000 men, including 3 000 marines, and is equipped with four submarines, three destroyers, six missile-frigates and other warships. However, Colombia is also involved in a dispute with Venezuela over the border in the oil-rich Gulf of Venezuela and over migration from Colombia to Venezuela. (In 1981, under the pressure of internal problems, the countries decided to freeze their claims.)

Nicaragua and Honduras

Nicaragua has been under constant pressure from the defeated Nicaraguan national guards who, after the overthrow of Somoza's dictatorship, have found refuge in Honduras and have been enjoying Honduran military support. The Nicaraguan government has documented 37 attacks, 44 air space violations and 15 infiltrations from the Honduran territory in 1981 [31–33]. There have been direct clashes between Honduran and Nicaraguan troops [34, 35], as a result of which the border between these two countries was closed in April 1981. The USA has applied some economic sanctions against Nicaragua and has threatened further action, including a naval blockade, because of what it considers to be continued Nicaraguan support for the opposition forces in El Salvador. In 1981 the United States carried out a series of naval manoeuvres in Central America together with certain states of the sub-region, which were understood as a show of force with regard to Nicaragua.

In light of all these external threats, Nicaragua is training some 200 000 men and women for the so-called popular militia, and has increased its standing army to 50 000, making it more than twice the size of any other Central American army. Nicaragua is the only country in Central America with heavy tanks, having reportedly received Soviet-built T-54 and T-55 tanks from some Arab and Socialist countries [36]. Moreover, at the end of 1981, in defiance of US Latin American policy, France agreed to sell military equipment to Nicaragua, including two fast patrol boats, two helicopters with rockets, and a dozen trucks. The contract contains a clause prohibiting re-export of the equipment.

Honduras is seeking to replace its fighter and transport planes from the 1950s with sophisticated jet aircraft and to acquire tanks to counter the Nicaraguan tanks. In 1981 it increased its military spending by 25 per cent.

Guatemala and Belize

Another long-standing issue has been the claim by Guatemala to Belize, a territory of some 150 000 inhabitants which was formerly under the sovereignty of the United Kingdom but in 1981 gained independence. Although significant economic concessions have been offered to Guatemala (including access to ports and exploitation of the sea-bed [37] as well as facilities for transit over the Belize territory), the Guatemalan government continues to question the right of Belize to sovereignty. It voted against Belize's admission to the United Nations.

A contingent of some 1 600 British troops is to remain in Belize for an undefined period. These troops are equipped with jet aircraft capable of verticle take-off and landing, guided rockets, helicopters and ground-to-air missiles [38]. Thus, a possible armed clash provoked by Guatemala would automatically acquire an extra-continental dimension.

Panama and the USA

The Panama Canal linking the Pacific and the Atlantic Oceans has for decades been a bone of contention between the United States and Panama and other Latin American states. The Canal's military importance to the United States is obvious: it permits a much more rapid deployment of naval forces than would be possible if ships had to sail around the cape of South America.

On 1 October 1979 two USA–Panama treaties entered into effect, abolishing the Canal Zone as a separate legal entity. The first treaty established procedures for the gradual transfer to Panama of operational control of the Canal and of the responsibilities for its defence: in the year 2000 the Canal is to be turned over to Panama, and all US forces are to be withdrawn. The second treaty established a framework for continued US interest in the security of the Canal after the year 2000, when both countries will jointly guarantee a permanent 'regime of neutrality' in the Canal with no US military presence on Panamanian soil. The USA has nonetheless retained the right to act unilaterally to protect the Canal and to maintain its neutrality, as well as the right to transit the Canal with its vessels of war and auxiliary vessels. Although the treaties have defused a major political controversy in the region, serious problems have emerged in connection with the implementation of those provisions which deal with the transfer of administrative and police functions from the USA to Panama [39].

At the time the USA–Panama treaties entered into force, 9 500 US troops were stationed in the Canal Zone (7 000 of them army personnel), occupying 14 bases and installations. The major units included an infantry brigade, special forces, a jungle operations training centre, as well as logistical support with aeroplanes and helicopters, The USA maintains an intelligence communications facility on Galeta Island to track Soviet naval forces in the Caribbean. Moreover, the Canal Zone has been a major training area for Latin American military forces: between 1950 and 1979 more than 82 000 military personnel received training there [40, 41], and two institutions (the US Army School of the Americas and the Inter-American Air Force Academy) conducted a wide range of courses, including training in counter-insurgency operations. (In 1980 as many as 300 Salvadorean military officers received training in such operations [42].)

IV. South America

Although there is no direct military threat to South America from extra-continental powers, the countries of this sub-region have since the mid-1960s been involved in a formidable expansion of their military potential.

In 1970 the six largest nations of South America, in terms of area and population—Argentina, Brazil, Chile, Colombia, Peru and Venezuela—accounted for 94 per cent of the military expenditures of all the 12 nations of this sub-region, or 75 per cent of the whole Latin American region. The corresponding figures for 1980 were 94 and 69 per cent, respectively. The latter percentage figure has decreased because of the increased militarization of Central America and the Caribbean.

During the past two decades, the strength of the military forces of the six countries has accounted for some 80 per cent of that of the total forces in the South American sub-region. However, important shifts have occurred in the composition of these forces. From 1960 to 1980 the strength of the army increased by over 50 per cent, in part because of the increased need of this service for the maintenance of internal security and suppression of internal opposition, while the strength of the naval and air forces rose by only some 30 per cent. Nevertheless, the latter two military services, jointly, have greatly increased their share in the total military appropriations: from some 25 per cent in 1960 to some 60 per cent in 1980.

These changes can be explained by the modernization of the navies and the air forces. New sophisticated major weapon systems, such as guided-missile destroyers, missile frigates, missile patrol boats, fighter-bombers and ground-based missiles, have made their appearance in the area. Most of these armaments have been imported from Italy, France, FR Germany and the United Kingdom, as well as from the USSR. Indigenous production of both major and small weapons in certain countries of South America has grown dramatically in the 1970s.

Brazil

Brazil, the largest and most populated country in Latin America (the size of the USA with half of its population), has become the leading regional economic power. In 1980 Brazil's GDP accounted for 42 per cent of the total for Latin America (excluding Cuba), and Brazil's growth rate has also been higher than that of the continent as a whole [2b]. Similarly, Brazilian armed forces are the largest in Latin America, larger than the armed forces of Argentina, Venezuela and Chile combined. Military spending in Brazil has been growing fast during the past decade, while other public expenditures have been heavily suppressed owing to tough anti-inflationary measures [43, 44]. On the other hand, the value of Brazilian arms purchases abroad (mainly from the USA) has been rather low as compared to those of other large countries of South America, such as Venezuela or Colombia. One reason for this is that Brazil is an arms-producing country, and 60 per cent of the military equipment used by its armed forces is produced in the country itself. Over 350 companies, employing 100 000 people, are directly involved in defence production [45, 46]. The most important arms-producing company in Brazil (EMBRAER) is that producing military aircraft. The following main types of aircraft are manufactured in Brazil, mostly on the basis of foreign licence: jet-powered combat aircraft, propeller and jet trainer aircraft, transport aircraft and maritime patrol aircraft. Aircraft engines are manufactured under Rolls-Royce and Pratt & Whitney licences, while helicopter production is based on a French licence (Aérospatiale).

The armoured vehicles industry turns out personnel carriers with a 90-mm gun (a joint Brazilian–Belgian venture), amphibious carriers and light reconnaissance vehicles. The output of the missile and rocket industry includes air-to-surface, surface-to-air, surface-to-surface (including anti-tank), and air-to-air missiles, guided and unguided, with a range from a dozen to a few hundred kilometres.

Brazil is planning to build a fleet of 150 modern naval units equipped with missiles and with nuclear propulsion. Brazilian shipyards produce frigates, destroyers, corvettes, fast patrol boats, landing ships, submarines and coastal boats. The Brazilian Navy has been traditionally anti-submarine-oriented (it played an important anti-submarine role in World Wars I and II).

Brazil exports arms to Third World countries and also to France, Belgium and the Soviet Union. The major recipients in the Third World are Libya, Iraq, Uruguay, Chile, Gabon, Togo and Tunisia. The supplies to these countries range from armoured vehicles and missiles to aircraft.

In 1981 Brazil supplied missiles to Iraq and concluded negotiations with Malaysia for the supply of as many as 700 armoured vehicles [47]. France and Belgium import Brazilian trainer aircraft (EMB–121 Xingu), which are generally recognized to be of very high quality, while the USSR imports armoured vehicles of the EE-9-Cascavel model. In addition, the Brazilian enterprise ENGESA and the US Bell Aerospace Division of Textron have jointly developed a wheeled amphibious carrier (the Hydrocobra) intended for the US Rapid Deployment Forces.

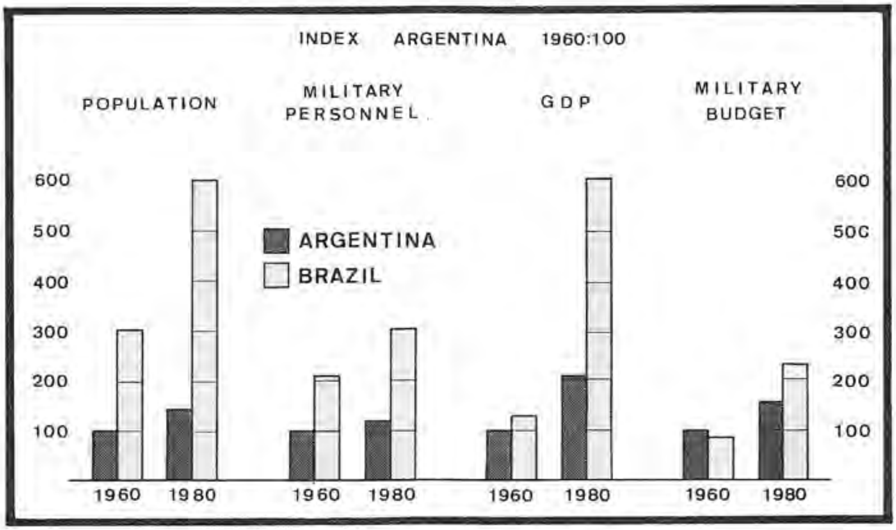
This enormous programme of the Brazilian military industry has been carried out with considerable governmental support. Significantly, the overall spending for science and technology in Brazil, which in 1979 represented 2.3 per cent of the federal budget, rose in 1981 to 5.3 per cent. The 1979 government appropriation for R&D for military purposes increased in current prices by 135 per cent as compared to 1975 [48]. In terms of industrial and military potential, Brazil has emerged as a great power, whose influence extends beyond the Latin American region.

Argentina

For many years Argentina has been Brazil's main competitor for economic and political influence in the neighbouring states (see figure 12.2). It is also the second largest military power in the sub-region. In the period 1970–80 the armed forces of Argentina increased by 35 per cent. At the same time, its police and paramilitary forces doubled their effectives (personnel). This latter development must be seen in light of the political and social convulsions suffered by Argentina during the past decade. Military expenditure increased by 51 per cent from 1970 to 1980.

Argentina's arms purchases abroad are considerably larger than those of Brazil. It imports aircraft and helicopters from Canada, France, Israel, Italy, the Netherlands, Switzerland, the United Kingdom and the USA; armoured vehicles from Austria, Belgium and France; warships from Canada, France, Israel, FR Germany (in particular submarines), Spain, the UK and the USA; and missiles from Israel, France, FR

Figure 12.2. Argentina and Brazil: a comparison, 1960–80



Germany, Sweden and the UK. (US arms export policies towards Argentina have undergone changes similar to those regarding other Latin American countries (see above).)

The level of indigenous arms production is lower in Argentina than in Brazil, but a steady expansion has been observed since 1967, when Argentina launched a plan to develop its domestic defence industry. The aircraft now produced in Argentina include a twin turboprop—the IA-58 Pucara, a multi-purpose attack plane, the primary mission of which is offensive reconnaissance and fire support on the battlefield, all important qualities for counter-insurgency tasks. A light transport plane is also manufactured, and an advanced jet trainer, the IA-63, is being developed with the technical assistance of a West German firm; a production run eventually exceeding 200 trainers is foreseen [49]. Hughes OH-6 helicopters are produced under US licence, and the indigenous contribution to this production is expected to rise from an initial 22 per cent to 50 per cent.

The armoured vehicles manufactured in Argentina include a 33-ton tank and an armoured personnel carrier, all based on French, West German and Swiss licences. The tank, Tanque Argentino Mediano (TAM), is the first medium tank produced by a Third World country and destined for Third World countries (*inter alia*, for Peru and Pakistan). It has a 105-mm cannon, a machine-gun and smoke-screen equipment, and a maximum range of 900 kilometres.

Argentina's shipyards build a wide variety of warships. In 1981 the following major units were being constructed or assembled: a destroyer and frigates equipped with missiles, attack submarines, corvettes and a transport ship. Argentina possesses the strongest navy in Latin America and is one of only two countries in the region and one of three countries in the entire Third World (together with Brazil and India) to possess an aircraft carrier.

The Argentine industry also turns out missiles and rockets developed by Argentina's Armed Forces Scientific and Technological Research Center (CITEFA), notably, a navy supersonic radio-guided missile, a wire-guided anti-tank missile and a fire-and-forget rocket. Sixty-eight per cent of the anti-tank missile's components are produced in Argentina [50].

The range of small arms manufactured in Argentina is wider than that in Brazil: from pistols, hand grenades and mortars, to automatic rifles and machine-guns, to all sorts of ammunition.

The largest government-owned armaments production conglomerate, Fabricaciones Militares Argentina (FMA), runs 12 military plants and has a majority or significant shareholding in the petro-chemical, steel, timber and construction companies. It employs an estimated 40 000 people directly, while a further 15 000 people work in associated companies.

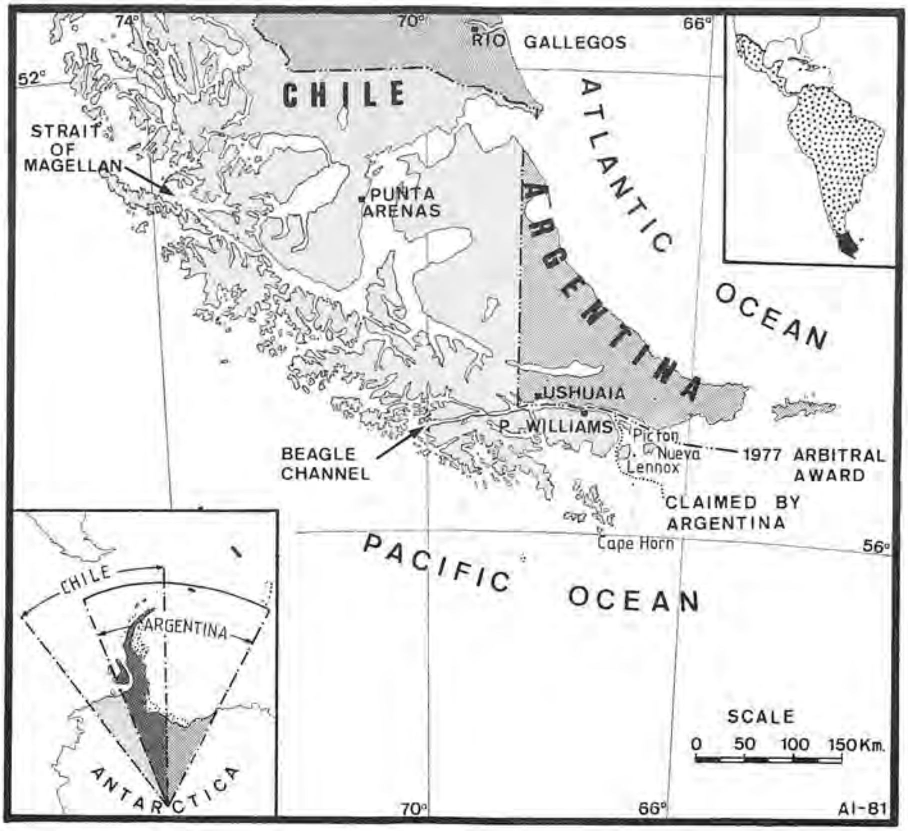
Argentina occupies seventh place among the Third World arms producers, but since its arms industry is smaller than that of Brazil, it ranks lower than Brazil as a weapon exporter. Argentina sells aircraft to Bolivia, Chile, the Dominican Republic, Iraq, Paraguay, Uruguay and Venezuela, and armoured vehicles to China, Pakistan and Peru.

In May 1980 important agreements were signed by Argentina and Brazil. The agreements covered *inter alia* scientific and technological co-operation, joint exploitation of hydroelectric resources and a permanent mechanism for political consultation. The most dramatic of these agreements was related to nuclear co-operation with the aim of achieving independence of both countries in the field of nuclear energy. In particular, Argentina was to supply Brazil with uranium concentrate and zircalloy tubes for nuclear fuel elements, while Brazil was to provide some of the pressure vessels and other components for an Argentine reactor. Moreover, both sides have established a programme of industrial co-operation in the field of aeronautics [51, 52]. These agreements may serve to moderate the rivalry between Argentina and Brazil.

Argentina and Chile

The existing dispute between Argentina and Chile is considerably more serious. The dispute is over the possession of three small and seemingly unimportant islands, Picton, Lennox and Nueva, at the mouth of the

Figure 12.3. Argentina and Chile: the territorial dispute



Beagle Channel in the Tierra del Fuego area (see figure 12.3). These islands are now under the jurisdiction of Chile. The treaties concluded at the end of the 19th century established a border between Argentina and Chile, but the parties never agreed on the actual delimitation of this border. Argentina claims that the dividing line between the Atlantic and the Pacific Oceans, which in its view constitutes the border in the area in question, should be the Meridian of Cape Horn. This would place the disputed islands under Argentine jurisdiction and would block Chilean access to the Atlantic except through Argentine-controlled water.

Argentina is concerned over effective control of Patagonia, the southern part of the country, where large numbers of Chileans have settled: the Argentinians are sensitive to Chilean demographic, cultural and political pressure in the area. Another reason for the intransigence of the parties is the competing claims in Antarctica.[4] Argentina feels that accep-

[4] The 1959 Antarctic Treaty froze all claims to territorial sovereignty in Antarctica for at least 30 years.

tance of Chilean rights to the Picton, Lennox and Nueva islands would strengthen Chilean claims to the Antarctic areas claimed by Argentina. This could perhaps also weaken its case in the dispute with the United Kingdom over the Falkland/Malvinas islands off the coast of Argentina. But the most fundamental reasons for intransigence are the economic considerations stemming from the trend towards general acceptance of a 200-mile exclusive maritime economic zone, as such a zone may eventually surround the disputed islands. Two specific resources are mentioned in this connection, namely, oil and krill (a small shrimp-like crustacean of considerable value as a source of protein).

The 1977 Arbitration Award, drafted by five members of the International Court of Justice and confirmed by the British Crown,[5] awarded the disputed islands to Chile, but Argentina promptly rejected it, arguing that the Court's decision contained errors and contradictions. This rejection caused a strong Chilean reaction and brought both nations to confrontation. Armed forces were mobilized and an arms race followed with a real possibility of open warfare.

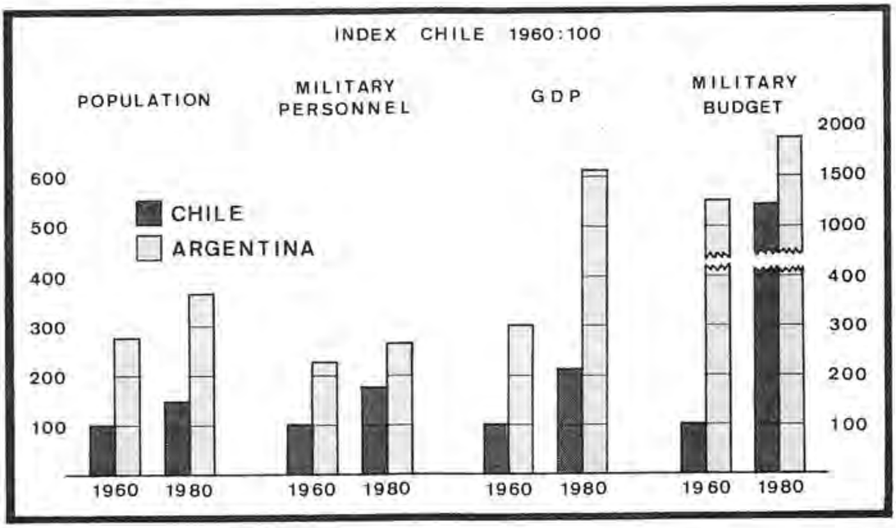
From 1977 to 1980 Chile doubled its military expenditure and imported a number of major weapons: 95 aircraft of different types and 30 helicopters from Brazil, Canada, France, the Netherlands, Spain, Switzerland and the USA; 16 missile-armed fast patrol boats from Brazil and Israel; 2 submarines from FR Germany; 2 landing-ships from France; and several thousand air-to-surface, surface-to-surface and surface-to-air missiles, mainly from France, Israel and South Africa. Chile is itself a producer of fast patrol boats (under Brazilian licence) and of landing ships (under French licence), as well as of armoured vehicles and small arms.

After the announcement of the 1977 Arbitration Award, Argentine arms imports rose steeply. In particular, orders were placed with FR Germany for 4 frigates, 4 destroyers, 6 corvettes and 6 submarines, some of the latter to be assembled in Argentina.

While Argentina is larger than Chile in terms of area, population, economic development and military forces (see figure 12.4), in case of war the relative strength would be less unequal: the main hostilities would probably take place at sea, and in terms of naval power Chile is rapidly approaching the level of Argentina, at least as regards the fleets active in the area of conflict. This area would comprise the Strait of Magellan, the Beagle Channel and Cape Horn, among other reasons, because the two countries are geographically separated by the barrier of the Andes Mountains.

[5] The role of Great Britain in this arbitration is based on the Treaty of Arbitration between Argentina and Chile concluded in 1902, and on the Arbitration Agreement of 1971.

Figure 12.4. Argentina and Chile: a comparison, 1960–80



A violent conflict between Argentina and Chile was averted in 1980 due to the acceptance by both sides of Vatican mediation. The Holy See's proposal for the solution of the dispute was handed over in December 1980 to the governments of Argentina and Chile. According to unofficial Argentine reports, the three disputed islands were to be considered Chilean under the Papal proposal. In addition, Chile and Argentina were to share a six-mile wide 'sea of peace'—a jointly controlled zone, running from the eastern edge of Nueva Island to the southern tip of Cape Horn [53, 54]. Argentina was greatly dissatisfied with the proposal and asked for "clarifications". The talks with the Papal emissary continued in 1981.

Given the strong nationalist feelings, military-strategic concerns and economic interests, the Argentine–Chilean conflict is not likely to be settled in the foreseeable future. Tension between Argentina and Chile heightened again in 1981 as a result of an allegation that an Argentine warship had intruded into Chilean waters south of Tierra del Fuego [55]. Moreover, in 1982 Argentina denounced the General Treaty on legal solutions of disputes, concluded with Chile in 1972.

Peru and Ecuador

The only regular armed conflict in South America in the past 20 years took place in January 1981 between Ecuador and Peru. The hostility broke out in a dispute over the so-called Amazonian Triangle (see figure 12.5), an area of some 200 000 square kilometres. The dispute

Figure 12.5. Ecuador and Peru: the territorial dispute

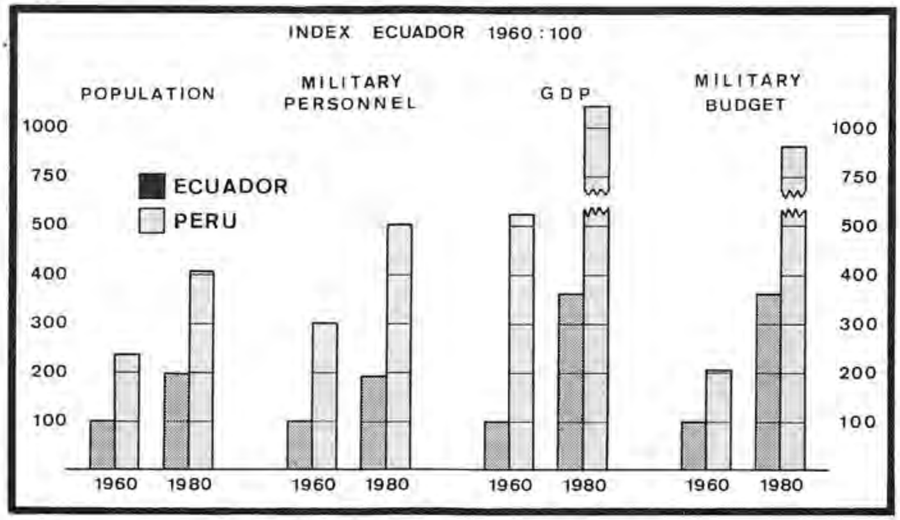
dates back to the 19th century and is due to an ill-demarcated frontier. A brief but violent armed clash in 1941, and the Protocol of Rio de Janeiro signed a year later, seemed to have settled the issue by awarding most of the former Ecuadorean jungle territory, equivalent to 55 per cent of the total land area of the republic, to Peru. However, Ecuador continued to harbour a sense of grievance and subsequently denounced the Protocol on the grounds that it had been concluded under duress.

The recent fighting started when Ecuadorean troops occupied outposts situated on what Peru claims to be its own territory. Peru moved in commandos and troops specially trained in jungle fighting to evict Ecuadorean forces. During the five days of hostilities Peruvian aircraft carried out 107 combat missions, including 24 bombing and strafing missions. Ecuador responded with artillery fire and missiles, destroying a few Peruvian helicopters. As a result, about 200 people were killed, largely from air strikes, and many others were wounded. Both sides sustained serious material losses.

The Peruvian Army is one of the most powerful in South America. Its effectives have doubled in the past 10 years; in 1980 they amounted to some 95 000, outnumbering the Ecuadorean armed forces by 3 to 1. The armed forces of Peru are also considerably better equipped than those of Ecuador. Peru has some 450 heavy tanks (Soviet T-54/55) and some 100 light tanks (French AMX-13), while Ecuador has some 40 heavy tanks (US M-3), some 80 light tanks (French AMX-13) and 30 armoured vehicles (US AML-60). Moreover, the Peruvian Air Force has some 120 combat aircraft of Soviet and French make, while Ecuador has only 55 combat aircraft of French and British make. The balance of naval forces is also in favour of Peru, which has 9 submarines (3 recently delivered by FR Germany, and others from the USA), 3 cruisers (2 from the Netherlands and 1 from the UK), and 9 destroyers (2 from the UK with surface-to-surface missiles, 2 from the USA and 5 from the Netherlands). Moreover, Peru has 2 Italian Lupo-class frigates, one with surface-to-surface and another with surface-to-air missiles, as well as 6 fast patrol boats with surface-to-surface missiles (from France), 11 patrol boats, 13 support ships and 20 helicopters for anti-submarine warfare (from the USA and France). Ecuador has 4 submarines (from FR Germany and the USA), 1 frigate (from the USA), 6 fast patrol boats with surface-to-surface missiles (from FR Germany), 9 patrol boats (from the USA) and 4 support ships (from the USA).

The Peru–Ecuador conflict has fuelled the arms race between the two countries. In the case of Peru the arms build-up was also justified by its century-old dispute with Chile over a territory which Peru lost to Chile during the Pacific War in 1879–83. (Bolivia, which in the same war lost access to the Pacific Ocean, maintains a state of hostility towards both Peru and Chile.) During the past 20 years, the military budgets of Ecuador and Peru have doubled (see figure 12.6). Recently, Peru ordered 14 fighter aircraft from Italy, 50 tanks from the USA, 2 missile frigates from Italy and 3 missile-armed fast patrol boats from France.

Figure 12.6. Ecuador and Peru: a comparison, 1960–80



while Ecuador placed orders for 1 destroyer from the USA, 6 missile-armed corvettes from France, 12 combat/bomber aircraft from Israel, and a number of fighter aircraft from the USA.

Following extensive diplomatic efforts by the Organization of American States, as well as by Argentina, Brazil, Chile and the United States—the four nations that guarantee the 1942 Rio de Janeiro agreement—Peru and Ecuador agreed in 1981 to cease fire and withdraw their troops from the disputed Cordillera del Condor mountain range and to re-establish peace. In spite of these arrangements, tension between the two countries continues. In particular, Ecuador has charged that Peruvian aircraft are violating Ecuadorean airspace. Considering that the area in dispute probably contains oil, the prospects for settling the Peru–Ecuador conflict are not bright.

V. Arms control

Denuclearization of Latin America

Latin America is the only part of the world which, as a whole, is subject to certain restrictive measures in the military field. The 1967 Treaty of Tlatelolco 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 nuclear weapons in Latin America. The extra-continental or continental states which are internationally responsible for territories lying within the limits of the geographical zone established by the Treaty (that is, France, the Netherlands, the UK and the USA) undertake to apply the statute of military denuclearization to these territories by adhering to Additional Protocol I annexed to the Treaty. Under Additional Protocol II, the nuclear weapon states undertake to respect the statute of military denuclearization of 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.

The importance of the nuclear weapon-free zone established by the Treaty of Tlatelolco, the first such zone in a populous region of the world, is undeniable. Nevertheless, the Treaty contains a few ambiguous points which may weaken its arms control impact. One of them is related to so-called peaceful nuclear explosions.

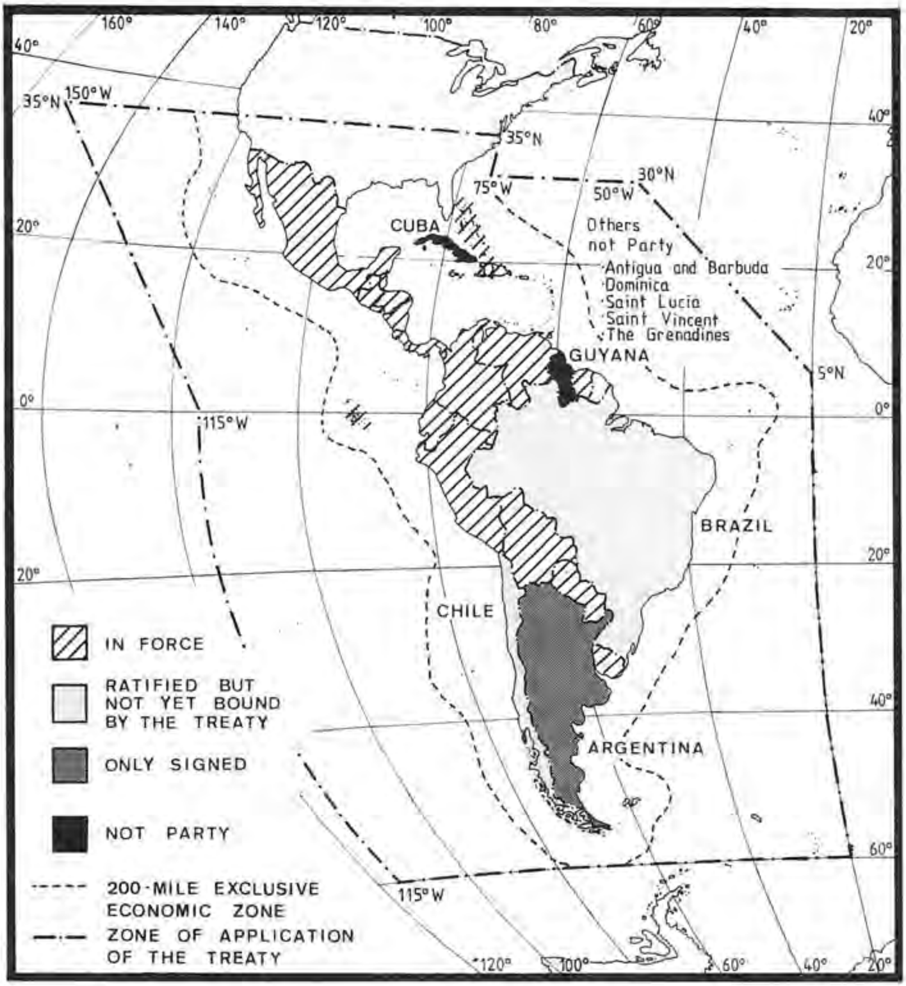
Explosions of nuclear devices for peaceful purposes are allowed under the Treaty and procedures for carrying them out are specified. A proviso is made that such activities must be in accordance with the article which prohibits the testing, use, manufacture, production or acquisition of nuclear weapons, as well as with the article which defines a nuclear weapon as "any device which is capable of releasing nuclear energy in an uncontrolled manner, and which has a group of characteristics that are appropriate for use for warlike purposes". Some countries interpret these provisions as prohibiting the manufacture of nuclear explosive devices for peaceful purposes unless or until nuclear devices are developed which cannot be used as weapons. Other countries consider that the Treaty has sanctioned peaceful explosions involving devices used in nuclear weapons. Thus, the important problem of compatibility of an indigenous development of nuclear explosive devices for peaceful purposes with participation in this nuclear weapon-free zone agreement has remained unresolved.

Another controversial point is the geographical extent of the Latin American nuclear weapon-free zone (see figure 12.7). The zone of application of the Treaty embraces the territory, territorial sea, airspace and any other space over which the zonal state exercises sovereignty in accordance with "its own legislation". But such legislation varies from state to state. In signing Additional Protocol II of the Treaty of Tlatelolco, France, the UK, the USA and the USSR stated that they would not recognize any legislation which did not, in their view, comply with the relevant rules of international law, that is, the law of the sea.

There may be more problems when large areas of the high seas in the Atlantic and Pacific Oceans, hundreds of kilometres off the coasts of signatory states and over which no state has claimed jurisdiction, are included in the nuclear weapon-free zone. This will happen upon fulfilment of the following requirements specified in the Treaty of Tlatelolco: adherence to the Treaty by all states in the region which were in existence when the Treaty was opened for signature; adherence to Additional Protocols I and II of the Treaty by all states to which they are open for signature; and the conclusion of safeguards agreements with the IAEA.

Furthermore, since neither transport nor transit of nuclear weapons has been explicitly prohibited by the Treaty, the question has arisen whether these activities are actually permitted. According to the interpretation given in 1967 by the Preparatory Commission for the Denuclearization of Latin America (COPREDAL), it was, for the following reasons, not necessary to include the term 'transport' in the article dealing with the obligations of the parties. If the carrier state were one of the zonal states, transport would be covered by the prohibition on any form of possession of nuclear weapons, "directly or indirectly, by the Parties themselves, by anyone on their behalf or in any other way". If the carrier were a state not party to the Treaty, transport would be considered identical with 'transit'. In this case, as the Preparatory Commission argued, the principles and rules of international law must apply, according to which it is the prerogative of the territorial state, in the exercise of its

Figure 12.7. The Treaty of Tlatelolco



sovereignty, to grant or deny permission for transit. In joining Additional Protocol II of the Treaty, France and the USA made a declaration of understanding to the same effect, while the USSR reaffirmed its position that authorizing the transit of nuclear weapons in any form would be contrary to the objectives of the Treaty. China considers that the passage of means of transportation or delivery carrying nuclear weapons through Latin American territory, territorial sea or airspace is prohibited. Indeed, once nuclear weapons are allowed to be in transit in Latin America, even if such transit is limited to port visits or overflights, it will be difficult to maintain that the zone has been totally denuclearized.

The Treaty of Tlatelolco is significant as the first agreement which embodies a legally binding restriction on the use of nuclear weapons.

But not all assurances given of non-use have been unconditional. The USA and the UK have reserved the right to reconsider their obligations with regard to a state in the nuclear weapon-free zone in the event of any act of aggression or armed attack by that state, carried out with the support or assistance of a nuclear weapon power. The USSR made a similar reservation with regard to a party to the Treaty committing an act of aggression with the support of, or together with, a nuclear weapon state. Whether or not such hedged guarantees conform to the spirit of Additional Protocol II is open to question. The Treaty itself does not allow reservations.

The Treaty of Tlatelolco was specifically intended to preclude the emergence of nuclear weapon powers in Latin America. The achievement of this goal requires adherence by all the states of the region. However, in 1981, 14 years after the signing of the Treaty, several countries of Latin America were still not bound by its provisions.

Cuba, which in 1962 allowed nuclear weapons to be stationed on its territory, has refused to sign the Treaty, the refusal being motivated mainly by the status of US–Cuban relations. Argentina has so far only signed the Treaty, while Brazil and Chile have signed and ratified it but, unlike other parties, have not waived the requirements (mentioned above) that are to be met (but have not yet been met) before the Treaty enters into force for any given country.

However, according to international law, Argentina, Brazil and Chile, as signatories of the Treaty of Tlatelolco, are obligated to refrain from acts which would defeat the object and purpose of the Treaty. (None of these countries is party to the 1968 Non-Proliferation Treaty.) Guyana, formerly a British territory, has been prevented from becoming a party to the Treaty of Tlatelolco because of its dispute with Venezuela over one-third of its territory. The Treaty provides that no decision shall be taken regarding the admission of a political entity, part or all of whose territory is the subject of a dispute between an extra-continental country and one or more Latin American states. Additional Protocols to the Treaty of Tlatelolco have been ratified by the powers concerned, with the exception of France, which at the end of 1981 was not yet party to Protocol I.

It is the attitudes of Argentina and Brazil, the two largest countries in Latin America and practically the only ones in the area with any nuclear weapon potential or aspiration, that will mainly determine whether the region remains free of nuclear weapons. This is even more so since each of these countries has stated that, according to its interpretation, the Treaty gives the parties the right to carry out, by their own means or in association with third parties, nuclear explosions for peaceful purposes, including explosions which involve devices similar to those used in nuclear weapons. However, 'peaceful' nuclear explosive devices could also be used as weapons: they are transportable and the amount of energy they are able to release could cause mass destruction. Any of these countries exploding such a device would *de facto* become a nuclear power, defeating the purpose of the Treaty of Tlatelolco.[6]

The Brazilian nuclear programme

As a result of secret talks started in 1974, an agreement was signed on 27 June 1975 between the Federal Republic of Germany and Brazil "on cooperation in the field of peaceful uses of nuclear energy" [57]. Under the terms of the agreement, which is to be in force for 15 years and may be extended for periods of five years, Brazil will buy a complete nuclear fuel cycle from FR Germany. The cycle will cover prospecting, mining and processing uranium ores in Brazil, as well as production of uranium compounds, uranium enrichment, construction of up to eight light water nuclear reactors of 1 300 MW each (using enriched uranium), manufacture of fuel elements, and reprocessing of irradiated fuels. The co-operation includes exchanges of technological information. Several joint enterprises are envisaged. Re-export or transfer to third countries of nuclear materials and equipment, including enriched uranium, uranium enrichment facilities and facilities for reprocessing spent reactor fuel, will be permitted under certain circumstances. Never before has such a comprehensive nuclear deal been concluded. Economically, it could mean vast energy supplies for oil-deficient Brazil at a time when its hydroelectric power will have been fully exploited, while FR Germany, in addition to immediate commercial gains, may get ensured access to the deposits of Brazilian uranium, which it will help to develop. Brazil's confirmed uranium reserves are estimated at 23 000 tonnes [58].[7] Politically, the deal may signify the creation of a new self-sufficient nuclear state with a nuclear weapon capability.

In particular, there is concern about the sale to Brazil of a uranium enrichment facility. Indeed, this is a novel item on a nuclear shopping list. The technology and investment required to enrich uranium to nuclear fuel levels is more difficult than the further step of reaching 'bomb-grade' levels.

However, the acquisition of plutonium reprocessing technology will suffice for Brazil to secure a nuclear military potential. It is the availability of plutonium which is essential, the design and manufacture of a nuclear

[6] For the text of the Treaty of Tlatelolco and of Additional Protocols, as well as the status of the implementation of these agreements, see reference [56].
[7] With present technology, annual consumption of uranium in a 1 000-MW reactor is estimated at about 140 tonnes.

explosive being no longer a very difficult task. The assurances that the plants for enrichment and reprocessing will be used exclusively to make reactor fuel, and the envisaged IAEA safeguards to prevent diversion, though unaffected by the termination of the co-operation agreement, will apply only to the equipment, installations and materials supplied by the Federal Republic of Germany, but not to those built indigenously.

Brazil undertook not to use the technological information received for the manufacture of nuclear weapons or other nuclear explosive devices. The transfer of technology is to be subject to IAEA safeguards, but such safeguards may be difficult to put into practice.

Brazil is planning nuclear co-operation with Colombia and Chile; more significantly, under the 1980 Brazil–Iraq 10-year agreement, Iraq is to receive Brazilian assistance in prospecting, production and refinement of uranium, and Iraqi technicians are to be trained in Brazil. Brazil is to supply Iraq with natural and low-enriched uranium, eventually in the form of fuel elements for nuclear reactors, as well as equipment and technology for reactor construction. This agreement raised international concern that Brazil might transfer sensitive technology received from FR Germany to one of the most turbulent regions of the world.

Brazil's first nuclear reactor, supplied by the US firm Westinghouse, should be operating at full capacity by the spring of 1982 [59]. In 1981 the US government, which according to its 1978 Nuclear Non-Proliferation Act prohibits supplies of nuclear material to countries such as Brazil that refuse to accept full-scope IAEA safeguards covering all peaceful nuclear facilities (both indigenous and imported), made a 'special case exemption' allowing Brazil to purchase enriched uranium for the US-supplied nuclear reactor. The West German–Brazilian deal envisaged that the ordered power stations would come off the assembly line at a rate of one a year from 1982 until 1989. But there are now grave doubts whether more than two of the eight stations will be built before the end of this century, mainly because of the increased costs of construction.

A small pilot uranium enrichment facility has already been installed in Brazil, but a full commercial-scale enrichment plant could hardly be operational before 1987. Plans for a pilot reprocessing unit were completed in 1979, but actual construction has been postponed. Thus, Brazil, whose striving for nuclear know-how in great part derives from its competition with Argentina for political and strategic influence in South America, is still a long way from acquiring the capacity to build a nuclear arsenal.

The Argentine nuclear programme

Argentina has one heavy water reactor of about 350 MW (using natural uranium), the only commercial one in operation in Latin America, and two reactors of 600 MW each under construction, one of which is expected to go critical in mid-1982. Its nuclear programme provides for four additional reactors to be in operation in 1997 [60]. Argentina's confirmed uranium reserves are estimated at 29 000 tonnes, and the production of uranium oxide in 1980 amounted to 700 tonnes. Argentina has built a fuel fabrication plant. Heavy water is imported from the Soviet Union but a heavy water production plant supplied by Switzerland is already being installed [61]. Argentina is also completing the construction of a plutonium reprocessing facility.

With its 1 000 physicists and engineers involved in extensive nuclear research, Argentina is more advanced than Brazil in the nuclear field. It is also less dependent upon foreign supplies and even intends to become a regional supplier of heavy water, research reactors, nuclear material and nuclear know-how. Under a 1977 agreement, supplemented in 1979, Peru has received an Argentine-built 'zero' power reactor. Agreements providing for the construction of reactors and/or training of nuclear technicians by Argentina have been signed also with Bolivia, Colombia, Uruguay and Venezuela. Other nuclear co-operation agreements of interest are those concluded by Argentina with India, Libya and the Republic of Korea. Argentina has accepted IAEA safeguards which apply to specific materials and individual plants imported under bilateral agreements, but refuses to commit itself to full-scope safeguards applying to all nuclear activities.

From the technological point of view, Argentina is certainly closer to the acquisition of a nuclear weapon capability than is Brazil. It is estimated that Argentina's power reactor has already produced enough plutonium, contained in spent fuel, to make several dozen nuclear bombs of the Nagasaki type. At the present time, however, spent fuel is being stored near the power reactor for possible future reprocessing.

Conventional armaments

There have also been attempts to limit conventional armaments in Latin America. In the 1974 Declaration of Ayacucho, commemorating the 150th anniversary of the battle which marked the end of Spanish domination in South America, the six members of the so-called Andean Group—Bolivia, Chile, Colombia, Ecuador, Peru and Venezuela (the Andean Group was created in 1969 for the purposes of sub-regional economic integration)—plus two non-members (Argentina and Panama) undertook to create conditions permitting an effective limitation of armaments and putting an end to their acquisition for offensive purposes. The stated aim of these measures was to devote all possible resources to the economic and social development of the countries in Latin America. Several consultative meetings of the Andean countries took place after the signing of the Declaration of Ayacucho with a view to translating its provisions into an internationally binding instrument. The following problems were discussed: the definition of arms limitation; the distinction between offensive and defensive weapons; the measurement and comparison of military expenditures of countries with different financial systems and different military set-ups; the modalities for the implementation of the limitations; and measures necessary to verify compliance with an agreement on the reduction of military expenditures, limitation of certain types of armament and prohibition of others.

In September 1975 representatives of the Andean states recommended their governments to include in the future agreement the prohibition of highly sophisticated and offensive weapons, the presence of which could upset peace in the area. The prohibition would cover biological, chemical and toxic weapons, weapons capable of altering the ecological balance, weapons using nuclear energy, attack aircraft carriers, all ballistic and long-range tele-guided systems, as well as heavy long-range bombers. The possibility of banning other weapons, such as bomber aircraft of all types, nuclear-powered submarines and cruisers, as well as certain types of artillery, certain types of tank, and tele-guided missiles of medium range, was also examined. With regard to the last three items, some representatives suggested that these should include artillery of a calibre larger than 155 mm, tanks equipped with weapons having a calibre larger than 105 mm, and guided missiles of a range exceeding 50 km. As a complementary measure, ceilings were envisaged for certain types of armament. Exchanges and co-operation among military organizations and military industries were also contemplated.

It was suggested that a treaty of unlimited duration should be concluded among the countries concerned, by which the parties would commit themselves not to use or threaten to use force against each other's territorial integrity or political independence and, in particular, not to invade or occupy the territory of another party, subject it to bombardment, blockade its harbours or coasts, or attack its land, naval or air forces, or merchant fleet. All disputes would have to be settled by peaceful means [62].

In 1978 a conference was convened, the first of its kind in the history of Latin America, to deal exclusively with the problem of conventional arms control in the region. This conference, held in Mexico City, was attended by representatives of Argentina, Bolivia, Colombia, Costa Rica, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru, Suriname, Trinidad and Tobago, Uruguay and Venezuela. The participants recommended *inter alia* initiation of studies and talks concerning possible limitations on transfer of certain types of conventional armaments to Latin America, and among the countries in the area, as well as limitations or prohibitions on conventional weapons considered to be excessively injurious or indiscriminate in their effects.

In September 1980 representatives of Colombia, Costa Rica, Ecuador, Panama, Peru and Venezuela met in Riobamba, Ecuador. They adopted a Charter of Conduct stressing the need for peaceful settlement of disputes and undertaking to set in motion the implementation of the principles of the Declaration of Ayacucho.

An agreement on conventional weapon restraints in Latin America would have obvious benefits for peace and security in the area, especially if adhered to by all militarily significant countries of the region. Since relations between Latin American states are in many cases characterized by rivalry or open conflict, confidence building aimed at reducing inter-state tension might create prerequisites for such an agreement.

Confidence-building measures

Most states in Latin America belong to the collective security system under the Charter of the Organization of American States. International disputes which may arise between American states are to be submitted to the peaceful procedures set forth in the Charter for the maintenance of continental peace and security.

However, the established mechanisms have not been sufficiently used. In particular, major disputes have not been settled within the inter-American system. On the other hand, a series of measures of a confidence-building nature in the military field are being carried into effect through bilateral or multilateral arrangements which include certain Latin American countries. For example, the Argentine and Brazilian navies conduct joint naval manoeuvres; Panama and Venezuela conduct joint manoeuvres of land, naval and air forces; Brazil and Uruguay conduct joint anti-submarine warfare exercises; and a group of Latin American countries conduct air force manoeuvres.

In addition, representatives of neighbouring states are often invited to observe manoeuvres carried out in border areas (as in the case of the Mexican land manoeuvres in 1980, to which high-standing Guatemalan officers were invited). Visits of naval units and exchanges of military missions among Latin American states are a common occurrence. Military academies are frequently attended by officers from different countries. And finally, the commanders-in-chief of the armies, navies and air forces of the Latin American states hold annual conferences in different capitals.

Thus, confidence-building measures in the military field, which are only now taking shape on a very modest scale in Europe, have been practised for quite a long time on a much larger scale in Latin America, although the term 'confidence building' has not been used in this context. An important drawback, however, is that in a number of events participation is not restricted to Latin American states alone. In particular, joint manoeuvres conducted together with US armed forces unavoidably assume the appearance of military bloc exercises, minimizing the confidence-building effect among the Latin American states themselves. It would seem, therefore, advisable for the countries in the region to institute confidence-building procedures which are independent of outside powers.

Furthermore, in view of the size of Latin America and because the Latin American states have different economic and security interests, sub-regional confidence-building arrangements could perhaps function more efficiently.

As far as the scope of the confidence-building measures is concerned, much could probably be done in the following fields: (*a*) exchange of information on military potential and advance notification of significant changes in the size and structure of the armed forces; (*b*) openness regarding military budgets and standardized reporting of military expenditures; (*c*) prior notification of movements of troops in border areas; (*d*) co-ordination of programmes for arms acquisition; (*e*) multilateral co-operation in conventional arms development and production; and (*f*) improvement of direct communications between the governments and establishment of so-called hot lines to serve in conflict situations.

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Part IV. Developments in arms control in 1981

13. Nuclear explosions

Square-bracketed numbers, thus [1], *refer to the list of references on page* 435.

As many as 1 321 nuclear explosions were conducted during the period from 1945 to 1981. The USA and the USSR are responsible for conducting over 87 per cent of all these explosions.

I. Explosions in 1981

Of the 49 nuclear explosions which took place in 1981, the USSR carried out 21. (Five of these were conducted outside the known Soviet weapon testing sites and are therefore presumed to have served non-weapon purposes.) The USA conducted 16 nuclear weapon test explosions in the usual site in Nevada; the UK conducted 1, also in Nevada; and France conducted 11 on the atoll of Mururoa in the Pacific Ocean. China did not test at all last year.

All explosions in 1981 were carried out underground and, according to data obtained from the Hagfors Observatory in Sweden, all had a yield below or around 150 kt (the yield of the French tests was 20 kt or below).

Since 1978 the rate of nuclear testing has remained at a level of about one per week.

In recent years there have been reports that the atoll where the French tests are conducted was severely damaged by explosions and that, as a result, radiation was leaking into the Pacific Ocean. It has been revealed that in 1979 a nuclear explosive device stuck half-way down the test shaft so that when it was fired, the explosion split the rock through to the sea and caused a tidal wave which damaged certain installations [1]. In addition to the complaints about these occurrences made by a French trade union and the protests by international ecological movements, there have also been official expressions of concern from Australia and New Zealand about possible nuclear pollution [2].

On 9 December 1981 the French Defence Minister, speaking in the French National Assembly, affirmed that the atoll of Mururoa was sinking due to natural processes rather than from repeated underground blasts. The Minister admitted, however, that on 11–12 March 1981 a storm had dispersed radioactive products from pre-1975 testing, contained under an asphalt surfacing. He added, without elaborating, that this had created "a new radiological situation" and that all the necessary precautionary measures had been taken [3].

II. Military significance of nuclear tests

Nuclear weapons are tested mainly in order to find ways of increasing their efficiency and to develop new weapon designs (particularly to improve yield-to-weight ratios); to study the effects of the blast, heat, radiation and fall-out produced by a nuclear explosion; to develop mechanisms to ensure the safety and security of nuclear devices; and to maintain confidence in the reliability of stockpiled weapons.

However, many scientists claim that nuclear weapon technology has reached a 'state of maturity': while further development may lead to some increases in the efficiency of the weapon or its adaptation to specialized missions, it is not likely to result in qualitatively new developments [4]. In fact, despite predictions which have been made, no significant break-throughs have taken place in this field for the past 20 years or more. Even the 'neutron bomb', a controversial political issue in recent years, is actually an invention of the late 1950s and early 1960s [5a]. Improvements in the performance of both strategic and tactical nuclear weapon systems are more the result of the evolution of the non-nuclear components, in particular the development of new delivery vehicles, than of improved designs of the nuclear explosive component. In other words, it seems that new military requirements could be met by previously tested, off-the-shelf designs.

Concerning the weapon effects, the more than 1 300 tests carried out during the past 36 years ought to have provided ample information. There are, of course, many uncertainties regarding a nuclear war, but those related to the physics of weapons are not fundamental and further testing to remove them is deemed to be of relatively little value [6].

To enhance the safety and security of nuclear devices, so-called permissive action links to prevent the use of weapons by unauthorized personnel, as well as use-denial mechanisms, which disable the nuclear warhead to prevent its use by terrorists, are being deployed. Moreover, insensitive high explosives which are resistant to crashes, fire or bullets are being developed [7]. Other improvements of this kind can certainly be made, but much can be accomplished without experimental explosions [5b].

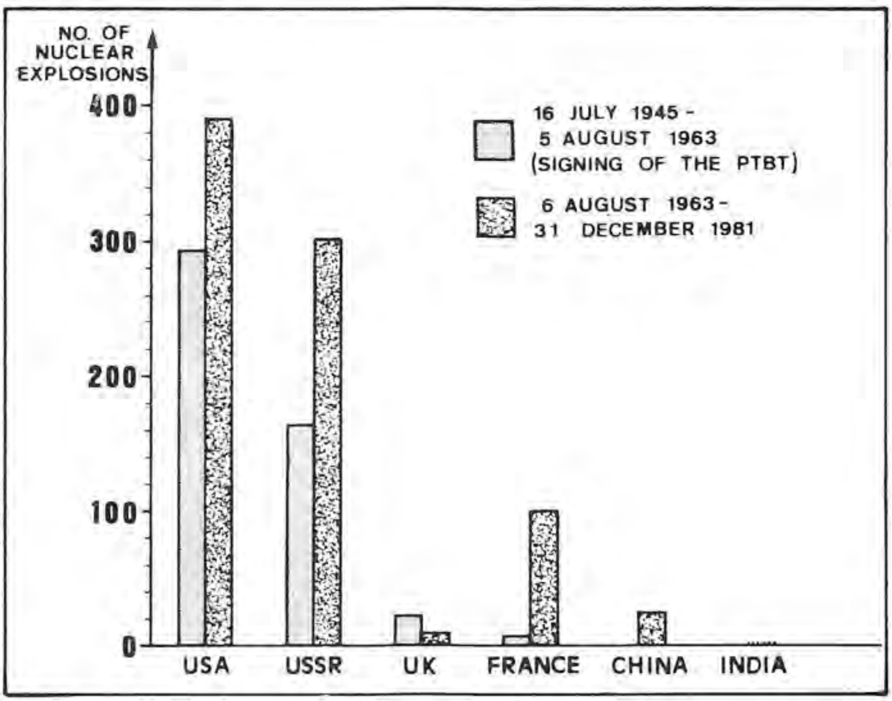
It is further contended that test explosions are needed to check the performance of existing weapons and to correct possible defects. However, there exists authoritative evidence that the continued operability of stockpiled nuclear weapons can be achieved by non-nuclear testing [8]. As a matter of fact, very few reliability tests have been conducted, at least in the USA. Even if nuclear weapons actually were subject to degradation in the arsenals, this could be considered a gain for the cause of arms control rather than a loss for international security, on the condition that the parties were equally affected.

Should confidence in the reliability of weapons diminish, this is more likely to influence those planning for first use than those planning for retaliation only. The effect, if any, would be to widen the fire-break between conventional and nuclear weapons and to shift the role of nuclear weapons gradually towards that of weapons useful only for the deterrence of nuclear attack [9].

III. Existing limitations on nuclear testing

The question of stopping nuclear weapon tests has been on the agenda of multilateral, bilateral (US–Soviet) and trilateral (UK–US–Soviet) negotiations ever since the early 1950s. More than 40 UN General Assembly resolutions dealing with this subject have been adopted over the past years, and on seven occasions the General Assembly condemned all nuclear tests in the strongest terms. Nevertheless, no comprehensive ban had been reached by 1982. The 1963 Partial Test Ban Treaty (PTBT), the 1974 Threshold Test Ban Treaty (TTBT) and the 1976 Peaceful Nuclear Explosions Treaty (PNET) (see chapter 17 for summaries of the provisions of the treaties)—the three partial agreements which have been signed so

Figure 13.1. Nuclear explosions conducted before and after the PTBT



far—have only circumscribed the environment for nuclear testing and reduced the size of the explosions. After the signing of the PTBT, for example, the USA and the USSR have carried out a considerably greater number of explosions than before (see figure 13.1). They have been able therefore to develop new generations of nuclear warheads and delivery vehicles, and the nuclear arms race has continued unhampered. The commitment under the TTBT to restrict the number of tests to a minimum has had little or no effect on the testing activities of the major powers, and the yield threshold established by this Treaty—150 kt—is so high (more than 10 times higher than the yield of the Hiroshima bomb) that the parties cannot be experiencing onerous restraint in continuing their nuclear weapon programmes. Finally, the PNET restrictions have only provided an indispensable complement to the TTBT to ensure that peaceful nuclear explosions should not provide weapon-related information that is not obtainable from limited weapon testing.

IV. Negotiations for a comprehensive test ban

In 1977 the UK, the USA and the USSR engaged in trilateral talks for the achievement of a comprehensive test ban (CTB), but in 1980, with the change of the US Administration, the talks were adjourned *sine die*. Up to that time a certain measure of agreement was reached among the negotiators [10].

Main points of agreement

The UK, the USA and the USSR agreed that: (*a*) a comprehensive test ban treaty should prohibit any nuclear weapon test explosion in any environment and be accompanied by a protocol on nuclear explosions for peaceful purposes, which would establish a moratorium on such explosions; (*b*) any amendment to the treaty would require the approval of a majority of parties, which majority should include all parties that are permanent members of the UN Security Council, and a conference would be held at an appropriate time to review the operation of the treaty; (*c*) the parties would use national technical means of verification at their disposal to verify compliance and would undertake not to interfere with such means of verification; an international exchange of seismic data would be established; and (*d*) the treaty would provide for consultations to resolve questions that may arise concerning compliance and any party would have the right to request an on-site inspection for the purpose of ascertaining whether or not an event on the territory of another party was a nuclear explosion.

While verification no longer seems to be a major obstacle, a series of complex technical problems related to verification remains to be solved.

Verification problems

Whatever additional methods might be used, seismological means of verification will certainly constitute the principal component of an international control system for an underground test ban. With this in mind, the Geneva-based Committee on Disarmament established an *ad hoc* group of scientific experts to consider international co-operative measures to detect and identify seismic events. The group has suggested that these measures should include a systematic improvement of procedures at seismological observatories around the globe, an international exchange of seismic data and the processing of the data at special international data centres.

In particular, the *ad hoc* group of experts considers that a seismological verification system should comprise about 50 globally distributed teleseismic stations selected in accordance with seismological requirements. These would be national facilities operated in accordance with generally accepted rules. The seismograph stations belonging to the system would routinely report the parameters of detected seismic signals, as well as transmit data in response to requests for additional information regarding events of particular interest. International centres would receive the data mentioned above; apply agreed analysis procedures to these data in order to estimate location, magnitude and depth of seismic events; associate identification parameters with these events; distribute compilations of the complete results of these analyses; and act as a data bank [11].

Although the global seismic network can provide a high degree of confidence that a comprehensive test ban is not being violated, there may still be events of uncertain origin. One way to reduce this uncertainty, which in most cases will be related to earthquake areas, could be for the state in question to provide seismic data for the suspected event from local stations not belonging to the global network.

The UK, the USA and the USSR agreed to develop measures of reciprocal verification, independent of the envisaged international co-operative measures, in order to obtain supplemental seismic data from high-quality, tamper-proof national seismic stations (NSSs) of agreed characteristics. Ten NSSs would be installed on the territories of the USA and of the USSR, but no agreement could be reached regarding the number of such stations in the UK. Questions regarding the specific locations of the NSSs, their emplacement and maintenance as well as the transmission of data produced by them have not been settled.

While the three negotiating powers agreed on the possibility of having on-site inspections, the procedure for setting in motion the inspection process (including the nature of the evidence needed to justify a request for on-site inspection), the modalities of the inspection itself (including the equipment to be used), as well as the number, rights and functions of the inspectors, have yet to be specified.

Other unresolved issues

Among other issues which remain to be settled is the status of laboratory tests which could, for example, consist of extremely low-yield nuclear experiments or the so-called inertial confinement fusion [12].

Extremely low-yield nuclear experiments could involve an explosion of a device which may have the same characteristics as a nuclear explosive device but which uses fissile material of an amount or kind that produces only a fraction of the yield of the chemical explosion that sets off the release of the nuclear energy. The question is whether such a test, which could be conducted in a laboratory, should be considered a nuclear weapon test explosion. The inertial confinement concept is to use lasers or other high-power sources to heat and compress small pellets containing fusionable fuel (deuterium and tritium). If a properly shaped pulse of sufficient energy can be delivered to the pellet, the density and temperature may become high enough for fusion. This would be a laboratory nuclear explosion of tiny proportions.

It may be argued that, in order to be effective, a comprehensive test ban should cover all explosions without exception, including laboratory tests. On the other hand, it can be contended that a comprehensive test ban could not cover laboratory tests because they are contained and not verifiable, and also because some of them may be useful for various peaceful purposes, including the development of new sources of energy.

Yet another point at issue is the duration of a comprehensive test ban treaty. The treaty negotiated trilaterally was planned to have a duration of no more than three years. The USA did not want to make a provision for a possible extension of the ban, while the USSR preferred to stipulate that the ban would continue unless the other nuclear weapon powers, not party to the treaty, continued testing. A ban of fixed duration would not fulfil the pledge included in the PTBT to achieve the discontinuance of all test explosions of nuclear weapons for all time. Moreover, a treaty of short duration would create a problem with respect to the adherence of non-nuclear weapon states, particularly parties to the NPT, which have renounced the possession of nuclear explosive devices for a much longer period. Finally, resumption of tests upon the expiration of a short-lived comprehensive test ban treaty would probably hurt the cause of arms limitation and disarmament more than if the treaty had never been entered into.

V. Conclusions

The discontinuation of nuclear weapon test explosions would not stop all improvements in nuclear warheads; certain improvements do not require tests involving nuclear reactions. A CTB would, nevertheless, have an arms limitation impact in that it would make it difficult, if not impossible, for the nuclear weapon parties to develop new weapon designs and would place constraints on the modification of existing designs. It would thereby narrow one channel of arms competition among the major powers. The arms control benefits could be further enhanced if the CTBT were followed by a ban on the production of fissionable material for weapon purposes. Such a 'cut-off' would slow the manufacture of nuclear weapons and could perhaps even be a step towards eventually ending this manufacture.

A CTB would also reinforce the Non-Proliferation Treaty by demonstrating the major powers' awareness of their legal obligation to bring the nuclear arms race to a halt. On the other hand, it is not certain that it would actually hinder the further proliferation of nuclear weapons, since a test explosion may not be absolutely essential for constructing at least a simple fission device. Nor is it certain that a CTB would provide sufficient incentives for the present non-NPT states to join the NPT, especially if these states have kept their nuclear weapon option open irrespective of the behaviour of the great powers, or if they consider that the mere cessation of tests by the nuclear weapon states is not a sufficient *quid pro quo* for their renunciation of nuclear weapons.

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Appendix 13A

Nuclear explosions, 1980–81 (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*) Hagfors Observatory of the Research Institute of the Swedish National Defence, and

(*d*) press reports.

2. Events marked with an asterisk * may be part of a programme for peaceful uses of nuclear energy in view of their location outside the known weapon testing sites.

3. m_b (body wave magnitude) indicates the size of the event; the data have been provided by the Hagfors Observatory of the Research Institute of the Swedish National Defence.

4. 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 1980 (revised data)

Date (GMT)	Latitude (deg)	Longitude (deg)	Region	m_b
USA				
28 Feb	37.126 N	116.088 W	Nevada	
8 Mar	37.180 N	116.083 W	Nevada	
3 Apr	37.149 N	116.082 W	Nevada	5.2
16 Apr	37.101 N	116.031 W	Nevada	5.6
2 May	37.056 N	116.019 W	Nevada	
22 May			Nevada	
12 Jun	37.281 N	116.454 W	Nevada	5.6
24 Jun	37.023 N	116.034 W	Nevada	
25 Jul	37.255 N	116.477 W	Nevada	5.6
31 Jul	37.012 N	116.023 W	Nevada	
25 Sep	37.056 N	116.048 W	Nevada	4.9
25 Sep	37.115 N	116.065 W	Nevada	
31 Oct	37.211 N	116.205 W	Nevada	5.3
14 Nov	37.109 N	116.002 W	Nevada	
USSR				
4 Apr	49.968 N	77.777 E	E Kazakh	5.1
10 Apr	49.813 N	78.140 E	E Kazakh	5.3
25 Apr	49.946 N	78.808 E	E Kazakh	6.5
22 May	49.759 N	78.102 E	E Kazakh	5.8
12 Jun	49.990 N	79.027 E	E Kazakh	6.1
29 Jun	49.923 N	78.860 E	E Kazakh	6.8
13 Jul			E Kazakh	5.0
31 Jul	49.812 N	78.169 E	E Kazakh	5.5
14 Sep	49.979 N	78.883 E	E Kazakh	7.3
20 Sep			E Kazakh	4.9
25 Sep	49.713 N	77.986 E	E Kazakh	4.9
30 Sep			E Kazakh	4.6
30 Sep			E Kazakh	5.2
8 Oct	46.748 N	48.288 E	W Kazakh*	5.7
11 Oct	73.313 N	55.021 E	Novaya Zemlya	6.6
12 Oct	49.912 N	79.050 E	E Kazakh	6.2
1 Nov	61 N	98 E	Central Siberia*	4.7
10 Dec	61.713 N	67.018 E	W Siberia*	4.8
14 Dec			E Kazakh	7.0
26 Dec			E Kazakh	4.6
27 Dec			E Kazakh	6.9
UK				
26 Apr	37.247 N	116.422 W	Nevada	5.8
24 Oct	37.075 N	115.999 W	Nevada	
17 Dec			Nevada	5.3
France				
23 Feb			Mururoa	
3 Mar			Mururoa	
23 Mar	21.872 S	139.066 W	Mururoa	
1 Apr	21.881 S	138.809 W	Mururoa	
4 Apr			Mururoa	
16 Jun	21.979 S	138.905 W	Mururoa	
21 Jun			Mururoa	
6 Jul			Mururoa	
19 Jul	21.871 S	139.004 W	Mururoa	
25 Nov			Mururoa	
3 Dec			Mururoa	
China				
16 Oct			Lop Nor (in atmosphere)	

II. Nuclear explosions in 1981 (preliminary data)

Date (GMT)	Latitude (deg)	Longitude (deg)	Region	m_b
USA				
15 Jan	37.087 N	116.045 W	Nevada	6.0
5 Feb	37.011 N	116.032 W	Nevada	
25 Feb	37.182 N	116.084 W	Nevada	
30 Apr	37.177 N	116.085 W	Nevada	
29 May	37.084 N	115.998 W	Nevada	
6 Jun	37.306 N	116.325 W	Nevada	5.6
10 Jul	37.106 N	116.005 W	Nevada	
16 Jul	37.089 N	116.019 W	Nevada	
5 Aug			Nevada	
27 Aug	37.160 N	116.067 W	Nevada	
4 Sep	37.026 N	116.023 W	Nevada	
24 Sep	37.009 N	116.024 W	Nevada	
1 Oct	37.082 N	116.009 W	Nevada	5.4
11 Nov	37.076 N	116.068 W	Nevada	5.4
3 Dec			Nevada	4.8
16 Dec			Nevada	4.6
USSR				
29 Mar	49.960 N	78.936 E	E Kazakh	6.3
22 Apr	49.915 N	78.879 E	E Kazakh	7.0
25 May	68.182 N	53.689 E	European USSR*	5.8
27 May	49.963 N	78.992 E	E Kazakh	6.1
5 Jun			E Kazakh	4.7
30 Jun	49.706 N	78.022 E	E Kazakh	5.4
5 Jul			E Kazakh	4.6
17 Jul	49.778 N	78.220 E	E Kazakh	5.3
14 Aug	49.779 N	78.078 E	E Kazakh	5.3
2 Sep			Ural Mountains*	4.6
13 Sep	49.882 N	78.971 E	E Kazakh	7.0
26 Sep	46.778 N	48.242 E	W Kazakh*	5.5
26 Sep	46.714 N	48.240 E	W Kazakh*	5.6
30 Sep			E Kazakh	4.6
1 Oct	73.297 N	54.831 E	Novaya Zemlya	5.8
18 Oct	49.891 N	78.877 E	E Kazakh	7.1
22 Oct	63.755 N	97.570 E	Central Siberia*	4.6
20 Nov	49.757 N	78.201 E	E Kazakh	5.2
29 Nov			E Kazakh	6.7
22 Dec			E Kazakh	4.9
27 Dec			E Kazakh	7.3
UK				
12 Nov			Nevada	5.6
France				
27 Feb			Mururoa	
6 Mar			Mururoa	
28 Mar			Mururoa	
10 Apr			Mururoa	
8 Jul			Mururoa	
11 Jul			Mururoa	
18 Jul			Mururoa	
3 Aug	21.896 S	138.909 W	Mururoa	
11 Nov	22.047 S	138.958 W	Mururoa	
5 Dec			Mururoa	
8 Dec			Mururoa	

Appendix 13B

Nuclear explosions, 1945–81 (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. 6 August 1963–31 December 1981

a atmospheric
u underground

	USA		USSR		UK		France		China		India		
Year	a	u	a	u	a	u	a	u	a	u	a	u	Total
6 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	12	0	27	0	2	0	7	2	1	0	0	**51**
1979	0	15	0	29	0	1	0	9	0	0	0	0	**54**
1980	0	14	0	21	0	3	0	11	1	0	0	0	**50**
1981	0	16	0	21	0	1	0	11	0	0	0	0	**49**[b]
Total	**0**	**390**	**0**	**305**	**0**	**11**	**41**	**59**	**22**	**4**	**0**	**1**	**833**

III. 16 July 1945–31 December 1981

USA	USSR	UK	France	China	India	Total
683	469	34	108	26	1	**1 321**

[a] Five devices used simultaneously in the same test are counted here as one.
[b] The data for 1981 are preliminary.

14. Arms control in outer space

Square-bracketed numbers, thus [1], refer to the list of references on page 445.

I. The Outer Space Treaty

The Outer Space Treaty, which was signed in January 1967 and entered into force in October of the same year, laid down the principles governing peaceful activities of states in outer space. However, only one clause of this Treaty (Article IV) is directly related to arms control: elaborating on a UN General Assembly resolution, unanimously adopted in 1963 [1], it 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. (Although "weapons of mass destruction" have not been defined in the Treaty, the general understanding of the negotiators was that, in addition to nuclear, they included at least chemical and biological weapons as well.) The establishment of military bases, installations and fortifications, the testing of any types of weapon and the conduct of military manoeuvres on celestial bodies have been also forbidden.

From the technological point of view, weapons of mass destruction, if placed in orbit around the Earth, would have serious drawbacks. Hitting a predetermined target on the Earth's surface, which lies on the path defined by the orbit, would be feasible only at certain hours or on certain days. A malfunction of the orbiting weapon could cause unintentional large-scale damage on the territory of the enemy or even a third state, as well as of the launching state itself. There would also be problems of maintenance and command and control. The weapon could be relatively easily intercepted or rendered inoperative. Putting the weapons in question on manned orbiting stations would remove only some of these operational inconveniences. On balance, the disadvantages of placing nuclear or other weapons of mass destruction in outer space outweigh their military usefulness. Therefore, in agreeing to ban them, the USA and the USSR have sacrificed little, if anything. Both powers continue to rely on ground-based and sea-based nuclear weapons which can both be better maintained and controlled, and also launched with greater accuracy.

II. Other agreements

Other arms control measures regarding outer space include the prohibition on testing nuclear weapons in this environment (under the 1963 Partial Test Ban Treaty); the ban on the development, testing or deployment of space-based anti-ballistic missile (ABM) systems or their components (under the 1972 ABM Treaty); an undertaking not to engage in military or any other hostile use of environmental modification techniques, defined as techniques for changing the dynamics, composition or structure of the Earth or of outer space (under the 1977 ENMOD Convention); and the proscription of fractional orbital bombardment systems (FOBS), capable of launching nuclear weapons into an orbital trajectory and bringing them back to Earth before the weapons complete one full revolution (under the 1979 SALT II Treaty). In addition, the Agreement governing the activities of states on the Moon and other celestial bodies, which was worked out in 1979, has amplified the relevant provisions of the Outer Space Treaty by prohibiting any threat or use of force or any other hostile act or threat of hostile act on the Moon, as well as the use of the Moon in order to commit any such act or to engage in any such threat in relation to the Earth, the Moon, spacecraft, the personnel of spacecraft or man-made space objects.

The 1968 Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space, the 1972 Convention on international liability for damage caused by space objects, and the 1975 Convention on registration of objects launched into outer space all address themselves to technical and legal aspects of international co-operation in the exploration and use of outer space for peaceful purposes.

However, the outer space environment has not been denuclearized. In particular, the flight through outer space of ballistic missiles carrying nuclear weapons from one point to another on the Earth's surface has not been forbidden. Neither has the deployment in outer space of weapons not capable of mass destruction been subject to any restriction. The USA and the USSR are engaged in developing devices capable of intercepting or disabling satellites in orbit, adding a new dimension to the arms race.

Since the danger of a war conducted from another planet against a state on Earth is an unrealistic prospect, the arms control effect of the undertaking to use celestial bodies exclusively for peaceful purposes is even scantier than that of banning orbiting weapons of mass destruction.

III. Prospects for further measures

The complete demilitarization of outer space is unattainable as long as ballistic missiles exist in weapon arsenals. Nevertheless, certain further measures to prevent an arms race and reduce the risk of military confrontation in outer space are conceivable, and the 1978 UN Special Session devoted to disarmament called for appropriate negotiations to be held in conformity with the spirit of the Outer Space Treaty [2].

In 1979 Italy suggested that an additional protocol to the Outer Space Treaty be signed to establish that outer space, including the Moon and other celestial bodies, shall be used for peaceful purposes "only", and, to this end, to extend the prohibition contained in Article IV of the Treaty. In particular, the parties to the protocol would undertake to refrain from engaging in, encouraging, or authorizing or participating in "any measures of a military or other hostile nature" in outer space, such as the establishment of military bases, installations and fortifications, the stationing of devices having the same effect, the launching into Earth orbit or beyond of objects carrying weapons of mass destruction or any other types of devices designed for offensive purposes, the conduct of military manoeuvres, as well as the testing of any types of weapon. The main objective pursued by Italy was to prohibit the development and use of Earth-based and space-based systems designed to damage, destroy or interfere with the operations of other states' satellites [3].

In 1981 the Soviet Union proposed a treaty of unlimited duration, which would prohibit the stationing of weapons of any kind in outer space, including stationing on "reusable" manned space vehicles (a clear reference to the US space shuttle programme). Moreover, the parties to the treaty would undertake not to destroy, damage, or disturb the normal functioning or change the flight trajectory of space objects of other states, if such objects were placed in orbit in "strict accordance" with the above-mentioned provision. Compliance with the treaty would be assured with the national technical means of verification at the disposal of the parties and, when necessary, the parties would consult each other, make inquiries and provide relevant information [4].

The Soviet proposal does not specify whether the development and testing of anti-satellite systems would be prohibited, and whether states would be obliged to dismantle those systems which they have already developed and tested. As a matter of fact, the draft treaty does not seem to prohibit anti-satellite weapons as such; only their deployment in space and use would be banned. One clause implies that these weapons may even be resorted to in case of violation of the agreement. In this context, it is not at all clear who would make the judgement as to whether or not objects were placed in orbit in accordance with the provisions of the treaty and, consequently, under what circumstances parties would be relieved from their undertaking not to interfere with space objects of other states. Moreover, whatever national means may be used to verify compliance, for the majority of nations lacking such means the treaty right to verify would be meaningless. Notwithstanding the apparent deficiencies of the Soviet text, the envisaged ban would be of significant importance as an arms control measure, were it to cover not only weapons placed in orbit but also weapons that could strike space objects from the ground and from the atmosphere.

A few rounds of talks on the possibility to control anti-satellite systems were held in 1978–79 between the USA and the USSR with the declared aims to preserve strategic stability and to ensure that treaties verified from space (by reconnaissance and early-warning satellites) are being complied with. But, given the states' growing dependence on space technology for communications or meteorology, for example, it is the international community as a whole that has the right and the responsibility to negotiate the appropriate measures. The Soviet proposal constitutes an important step towards multilateralization of such negotiations. An eventual agreement would have to be open for adherence by all states.

In a resolution adopted in December 1981, the UN General Assembly, taking into account the Soviet proposal, requested the Committee on Disarmament (CD) to embark on negotiations with a view to achieving agreement on the text of an "appropriate" treaty to prevent the spread of the arms race to outer space [5]. In another UN resolution, approved at the same time, the CD was requested to consider, as a matter of priority, the question of negotiating an effective and verifiable agreement to prohibit anti-satellite systems [6]. Indeed, the prevailing opinion in the United Nations is that an anti-satellite weapons treaty should be a point of departure of the process of averting the risk of war in outer space.

A formidable obstacle to reaching further arms control agreements relating to outer space is the fact that most satellites are used for military purposes. And, since satellites will remain highly vulnerable to attack for a long time to come, they will continue to be tempting military targets. On the other hand, unbridled great-power competition in the field of anti-satellite weaponry could be unbearably costly for both sides, as it would inevitably involve both offensive and defensive measures. Such competition would, moreover, generate pressure for pre-emptive action and would thereby decrease rather than increase the sense of security of the powers in question, bringing no advantage to either side.

The negotiators of new space-related treaties will first have to define the devices and/or activities to be prohibited in outer space. Further, the vexing problem of monitoring compliance with the agreed rules of behaviour will have to be dealt with, considering that a clandestinely acquired capability to interfere with the adversary's satellites could be decisive in modern warfare.

References

1. UN General Assembly resolution 1884 (XVIII).
2. UN General Assembly resolution A/RES/S-10/2.
3. Committee on Disarmament document CD/9, 26 March 1979.
4. UN document A/36/192.
5. UN General Assembly resolution 36/99.
6. UN General Assembly resolution 36/97C.

15. The prohibition of inhumane weapons: new small arms ammunition

Square-bracketed numbers, thus [1], *refer to the list of references on page* 453.

I. Introduction

On 10 April 1981 the Convention on prohibitions or restrictions of use of certain conventional weapons was opened for signature at the United Nations in New York. The general form of the treaty is that of an 'umbrella' covering a number of protocols. The existing three protocols to the treaty are on landmines and booby-traps, incendiary weapons, and fragments not detectable by X-ray. (The texts of the Convention and the three protocols, and a discussion of them, are to be found in the *SIPRI Yearbook 1981*.)

The Convention includes no reference to the new small-calibre, high-velocity military rifle bullets which had been given high priority in the preparatory conferences, beginning with the conference of experts called by the International Committee of the Red Cross in 1973 [1]. Humanitarian concern about the effects of various bullet wounds goes back to the St Petersburg Declaration of 1868 (which outlawed small exploding and incendiary bullets) and the Hague Declaration of 1899 (which outlawed dumdum bullets).[1]

Between 1868 and 1899, most of the military powers introduced ammunition of about 7.62 mm calibre—a calibre which is still widely used today—with greatly increased velocity compared with the older ammunition. Scientific studies have shown this that ammunition could cause devastating injuries at ranges of up to several hundred metres, and fears were expressed about the casualties to be expected in future wars. However, these fears proved largely unfounded because the great range of the new ammunition (in excess of 1 000 m), together with the rapid rate-of-fire, changed the nature of warfare. The infantry and the cavalry could no longer cross the no-man's land between opposing forces, and warfare 'degenerated' from the heroic charges of a previous generation to the trench warfare of World War I.

In recent years there have been increasing demands to replace 7.62 mm full-power ammunition with shorter-range, lighter-weight ammunition and guns. Soviet-supplied forces have long relied primarily on a reduced-power ammunition with an effective range of about 300–400 m but with

[1] For a full discussion of this topic, see reference [2].

the same calibre. NATO countries were obliged by the United States to retain the full-power 7.62 mm ammunition and the heavier weapons it requires. Yet it was the USA itself which introduced lightweight ammunition and rifles in Viet Nam and subsequently throughout its forces. The US ammunition has a smaller calibre, 5.56 mm, and a higher velocity. There is considerable evidence that at ranges of up to several hundred metres (at which some 90 per cent of bullet wounds occur) this smaller calibre ammunition caused worse injuries than the larger calibre. The reason is that the bullet retarded more rapidly, giving up more energy in the wound; in addition it very frequently broke up.

It was these characteristics that led to the description of the new bullets (by the head of a Swedish government delegation, later foreign minister) as "the dumdum bullets of today". The Swedish government, with varying degrees of support from others, has since 1973 endeavoured to clarify the medical and technical issues involved by means of a series of international symposia on the wounding effects of modern assault rifle bullets. With the pressures of Viet Nam removed, the USA became more willing to co-operate in these efforts. However, when in 1979, at the first session of the UN Conference on these weapons, the Swedish government proposed that the UN itself should sponsor the fourth of the series of symposia, the proposal was strongly opposed by the USSR. A few months later the Soviet forces entering Afghanistan were seen to be equipped with new weapons, with 5.45 mm ammunition, which also appears to have worse wounding effects than the ammunition it replaces.

The Fourth International Symposium on Wound Ballistics was nevertheless held in Gothenburg, Sweden in September 1981.

The fact that the USA—which supplied many other countries with the new calibre ammunition—introduced weapons with worse wounding effects led to fears of a new and dangerous trend in the arms race: a trend which at first appeared to be confirmed by the new Soviet ammunition. These fears were reinforced by the opposition of the major powers to accepting restrictions on small arms ammunition within the framework of the UN Convention.

Further examination of the new ammunition now being introduced in NATO suggests that this unfortunate trend may have been stopped, perhaps as a result of the initiatives taken by the Swedish and other governments.

II. The M-16 and its ammunition

The US M-16 rifle is designed around a modified Remington .223-in high velocity hunting bullet: that is, in common terminology, it uses a .22 calibre rather than a .30 calibre round. Early versions had a rifling of 1 turn in 14 inches (1-in-350 mm). This resulted in a bullet, designated M-193, which was not very stable in flight, particularly in cold air. This meant that in Arctic conditions it proved almost impossible to hit the target; it also meant that the bullet tumbled very readily on impact, or even impacted sideways, causing severe injuries.

After a few years a rifling twist of 1-in-12 (1-in-305 mm) was introduced, resulting in a somewhat more stable bullet, and probably reducing the average severity of wounds.

These very technical considerations are important when comparing the M-16 with recent developments.

Clinical reports of injuries in Viet Nam indicated very severe injuries resulting from the M-16. Subsequent experimental studies, where bullets are fired into standard blocks of soap or gelatin, or into anaesthetized live animals, also gave evidence that the M-16 produced more severe effects than standard full-power (NATO) or reduced-power (Soviet) 7.62 mm ammunition. These experiments enabled another factor to be controlled, namely barrel wear. The high-powered ammunition of the M-16 resulted in a problem of barrel wear, which in turn also leads to unstable, and thereby inaccurate but potentially more dangerous, bullets.

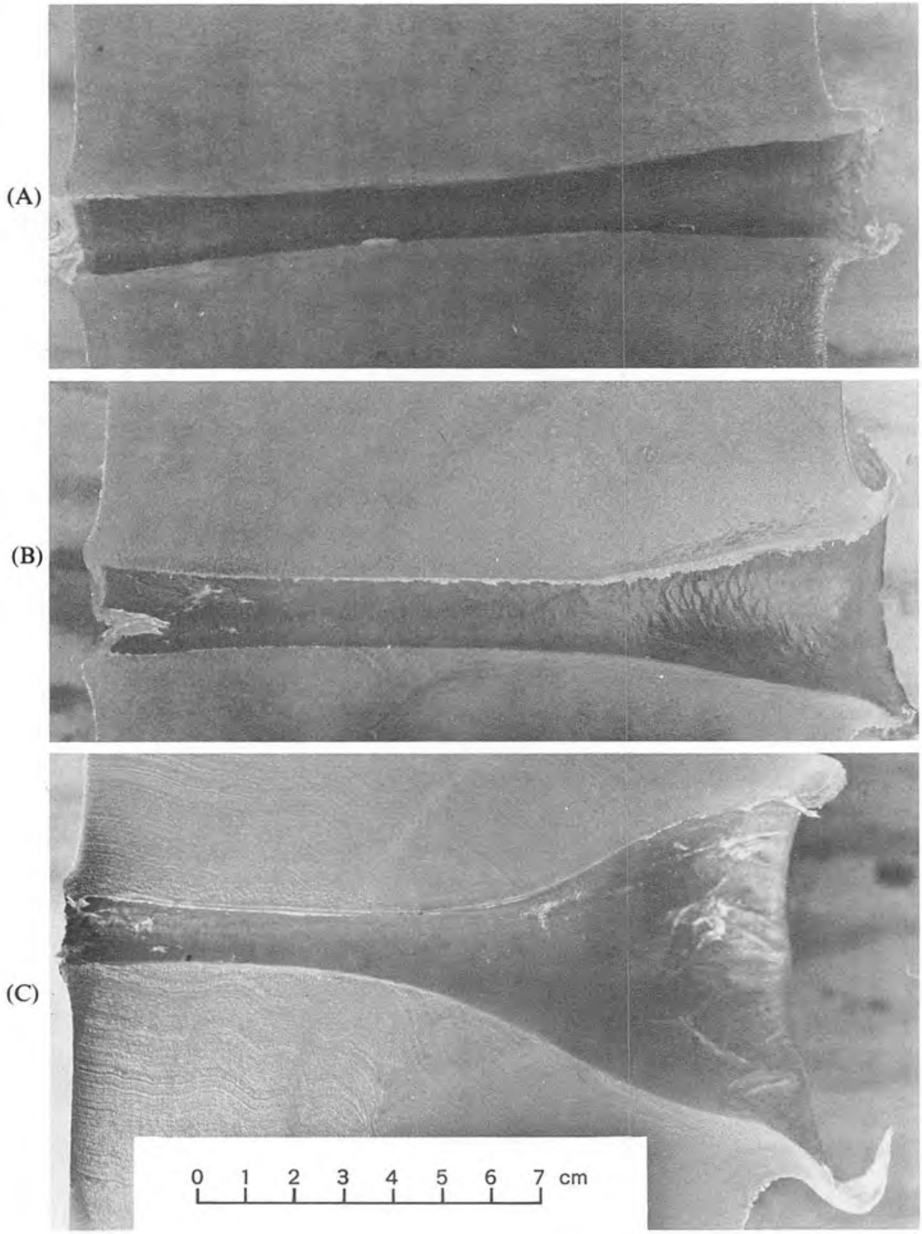
The M-16 ammunition was criticized not only on humanitarian but also on military grounds. The lightweight bullet proved to have limited ability to penetrate foliage, steel plate on vehicles or helmets. The range was too limited for use in machine-guns. Thus, although many other armies have considered the need for smaller-calibre, lighter-weight weapons, there has been much dispute about the relative pros and cons of the various calibres. Thus, the USA went on to experiment with 6 mm ammunition for use in a light machine-gun, while the UK and the Federal Republic of Germany produced ammunition of less than 5 mm.

As a result of this confusion, NATO instituted extensive trials in order to arrive at a new common standard.

III. The new NATO 5.56 mm ammunition

On 28 October 1980, NATO approved a second standard ammunition. The Belgium SS-109 round selected has 5.56 mm calibre but it differs from the US M-193 5.56 mm round. It is designed to be fired from a gun with a rifling twist of 1-in-178 mm. The resulting rate of spin makes it stable in flight over a long distance, as well as being more stable on impact. It contains a hardened steel and lead core which penetrates steel plate more effectively than the larger-calibre NATO ammunition.

Figure 15.1. Cross-section of the cavity formed by standard military rifle bullets fired from 100 m into blocks of soap the approximate size of a human thigh
(A) Soviet 7.62 × 39 mm bullet; (B) NATO 7.62 × 51 mm bullet; (C) US 5.56 × 45 mm bullet.



At the same time the designers appear to have taken account of the international concern about wounding effects and have produced a bullet which is said to be less severe than the M-193 round, having about the same effect as the 7.62 mm NATO ammunition (which is used in about 70 countries).

On the basis of the information published so far, it would seem that the Belgian designers have succeeded in producing a bullet which is militarily more effective (insofar as it can penetrate steel helmets at longer ranges) while at the same time being less objectionable from a humanitarian point of view.

A similar bullet, under the designation XM-855, is being manufactured by the United States. However, to be as effective, the barrels of the M-16 must be changed to ones with the 1-in-178 mm rifling. It seems likely that the USA will use up existing stocks of the M-193 ammunition and M-16 gun barrels and successively replace them with the new ammunition and new barrels or even new rifles, such as the M-16 PIP.

IV. The Soviet AK-74 and its ammunition

Not to be outdone, the Soviet Union has now introduced a smaller calibre assault rifle, the AK-74, and a light machine-gun, the RPKS-74. Both use 5.45 × 39 mm ammunition. The guns are very similar to those they replace, though somewhat improved.

Neither the Soviet ammunition nor the guns to fire it are substantially lighter than the ones they replace (they are already lighter than standard NATO 7.62 mm ammunition and rifles, and in fact slightly lighter than the Western 5.56 mm rounds and weapons). What, then, is the advantage of the new ammunition? The new *bullet* (not the *cartridge*) is about half the weight of the previous type. It is fired at higher velocity, giving a flatter trajectory and a greater accuracy at longer range. Further, the rifling of the gun (1-in-203 mm) makes the bullet very stable in flight. Even with the relatively high velocity (but which is less than that of the Western 5.56 mm bullets), the lightweight bullet has the lowest initial energy of any of the current military rifle bullets. This in turn raises questions about the lethality of the bullet.

Further examination of the bullet, however, shows that the Soviet designers have also considered this question. The bullet contains a mild-steel core surrounded by lead which forms a plug toward the tip of the bullet but fails to fill the tip. The centre of gravity is far to the rear ensuring that it will flip over when hitting the human body. It will thus very effectively deposit its energy in the body, causing an 'explosive type' wound, similar to that of the M-16. The steel jacket of the Soviet bullet makes it less liable to deformation or break-up than the US M-16 ammunition, while the mild-steel core gives it a greater ability to penetrate foliage or sheet metal.

There were at one time fears that the Soviet Union would adopt a 5.6 mm sporting bullet which causes more severe injuries than the M-16 ammunition. It now seems that they have not gone beyond the limits established by the USA.

V. The Fourth International Symposium on Wound Ballistics

The Fourth International Symposium on Wound Ballistics, held in Gothenburg, Sweden on 2–4 September 1981, covered a wide range of effects of wounding, predominantly wounding caused by small-calibre, high-velocity projectiles and mainly those from in-service rifles.[2] Work had previously been done on the more accurate detection of devitalized tissue and tissue which can be saved. Secondary effects of wounding had also been dealt with, for example in wounds caused by secondary fragments of bone which are driven many millimetres through the body after being struck by a bullet, thereby causing serious injury at some distance from the initial wound.

Eleven of the 34 papers presented at the 1981 Symposium dealt with the 'mechanical' effects of small-calibre, high-velocity bullets, in order to arrive at methods of measurement. Two approaches emerged from the Symposium experiments: many participants claimed that there were too many real-life variables to make it feasible to predict wound channels from experiments and that it was therefore impossible to create legislation; others argued that such evidence of the effects of missiles could establish some scale of the effects, with a view to restricting or prohibiting the use of those which caused the worst effects.

The Gothenburg Symposium was an effort on a technical level to reconcile the humanitarian and the military considerations for the design of small arms. What is needed now is the political will to prohibit by international law the ammunition which causes the most inhumane and indiscriminate wounds.

VI. Conclusions

The history of the M-16 and its successors enables a number of conclusions to be drawn. Once new standards are established by a great military

[2] The proceedings of the Third International Symposium on Wound Ballistics were published in reference [3]. It is understood that the proceedings of the Fourth Symposium will be published in the same journal.

power, they can spread rapidly throughout the world. The M-16 claimed victims not only in Indochina, but in Latin America, the Middle East and in Northern Ireland and Borneo.

Second, once again the Soviet Union demonstrated its determination to learn from US military experience, as well as its own.

Third, neither great power showed much respect for the rest of the international community or for efforts to restrain the development of new weapons by means of international humanitarian law.

Fourth, and more encouragingly, the new NATO standard does indicate that arms manufacturers and military authorities can be responsive not only to the 'technological imperative' but also to international public opinion.

It is to be hoped that the USA in its procurement policies, and the USSR in its development efforts, as well as other countries, will now pursue what is hopefully a tacit agreement to reverse the trend towards more inhumane small arms.

References

1. International Committee of the Red Cross, *Weapons that may Cause Unnecessary Suffering or have Indiscriminate Effects*, Report on the Work of Experts (ICRC, Geneva, 1973).
2. SIPRI, *Anti-Personnel Weapons* (Taylor & Francis, London, 1978).
3. *Acta Chirurgica Scandinavia*, Suppl. 489, 1979.

16. Disarmament at the 1981 UN General Assembly

Square-bracketed numbers, thus [1], *refer to the list of references on page* 458.

The 36th session of the UN General Assembly adopted over 50 resolutions on arms control issues. The most important resolutions are reviewed here.

I. Nuclear weapons

The Assembly reiterated its concern that nuclear weapon tests continued unabated against the wishes of the overwhelming majority of UN member states. It urged the UK, the USA and the USSR to resume their trilateral negotiations (interrupted in 1980) on a comprehensive test ban treaty (CTBT) and to bring them to an early conclusion [1]. It also requested the Committee on Disarmament (CD) to begin multilateral negotiations on a CTBT and, to this end, to establish a special working group, and called upon the UK, the USA and the USSR to halt, as a provisional measure, all their nuclear test explosions, either through a trilaterally agreed moratorium or through three unilateral moratoria [2].

The Assembly welcomed the commencement in November 1981 of US–Soviet negotiations on nuclear weapons, and urged that the strategic arms limitation process, begun by the conclusion of the SALT I agreements and the signature of the SALT II agreements, should continue and that the USA and the USSR, as signatory states, should refrain from any act which would defeat the object and the purpose of this process [3].

As in the previous years, appeals were made for nuclear weapon-free zones in different parts of the world. But the chances of having such zones, or 'zones of peace', actually set up, were not rated high: in Africa [4], in the Middle East [5, 6] in South Asia [7], or in the Indian Ocean [8], those being the regions specifically mentioned in the UN resolutions. The only positive development in this field that could be recorded by the General Assembly concerned Latin America: in November 1981, the United States deposited its instrument of ratification of Additional Protocol I of the Treaty of Tlatelolco, which prohibits nuclear weapons in Latin America [9]. Thereby the US Virgin Islands, the island of Puerto Rico and the US base of Guantanamo in Cuba have been submitted to the denuclearized regime.

As far as nuclear disarmament is concerned, most UN members consider the CD to be a suitable forum for the conduct of negotiations on the cessation of the production of nuclear weapons and on the reduction of their stockpiles, including their eventual elimination [10]. However, these negotiations are unlikely to be initiated in the foreseeable future in view of the strong objections on the part of the USA and its allies. On the other hand, the USSR and its allies are opposed to discussing a much less ambitious nuclear arms control measure—the cessation of the production of fissionable material for weapon purposes [11]—even though such a cut-off would certainly slow the manufacture of nuclear weapons and could perhaps even be a step toward ending such manufacture. The Soviet proposal for negotiating a convention to prohibit the production, stockpiling, deployment and use of neutron weapons was passed only by a narrow margin [12].

Reaffirming its call for effective international arrangements to assure non-nuclear weapon states against the use or threat of use of nuclear weapons [13], the Assembly suggested the conclusion of an international convention on the non-use of nuclear weapons in general, and declared that the use of such weapons would be a violation of the UN Charter and a crime against humanity [14]. This declaration was adopted by a considerable majority of states against the votes of the NATO countries, as was the declaration "on the prevention of nuclear catastrophe", which condemned the first use of nuclear weapons and the doctrines which envisage such use, although on this resolution a great number of states abstained [15]. The nuclear weapon states were requested to submit their views, proposals and practical suggestions for ensuring the prevention of nuclear war [16].

In a move related to nuclear arms control the Assembly referred to the 1981 Israeli attack against the Iraqi nuclear installations (already condemned by the IAEA General Conference) as an act directed against the IAEA and the nuclear safeguards regime [17]. It also expressed its "deep alarm" that Israel had the technical capability to manufacture nuclear weapons and possessed the means of delivery of such weapons (as stated in the report submitted by the Secretary-General) and requested the Security Council to prohibit all forms of nuclear co-operation with Israel [18].

The Assembly deplored the massive build-up of South Africa's military machine, including its "frenzied" acquisition of a nuclear weapon capability. The Security Council was asked to institute effective enforcement action against the South African regime so as to prevent it from endangering international peace and security through its acquisition of nuclear weapons [19].

II. Chemical weapons

While calling for the continuation of the negotiations on a convention prohibiting chemical weapons [20], the Assembly asked all states to refrain from any action which could impede such negotiations, and specifically to refrain from the production and deployment of binary and other "new" types of chemical weapons. It also requested that chemical weapons should not be stationed in those states where there are no such weapons at present [21].

Since the group of experts investigating the reports of the alleged use of chemical weapons (mainly US charges that the Soviet and Vietnamese forces had used toxic weapons in military operations in Afghanistan, Laos and Kampuchea) had not completed its work [22], the Assembly decided that this investigation should continue. Accordingly, the mandate of the group has been extended [23].

III. Other weapons

At the request of the Assembly a UN study will be carried out on all aspects of the conventional arms race and on disarmament relating to conventional weapons and armed forces. A group of qualified experts, appointed by the Secretary-General, is to be set up on a balanced geographical basis [24].

States have been asked to report annually (by 30 April) their military expenditures of the latest fiscal year for which data are available, making use of the standardized reporting instrument. The intention is to make these data an integral part of the regular UN statistical publications [25].

The Committee on Disarmament has been given the task of working out agreements to prevent the spread of the arms race to outer space, taking into account the Soviet draft treaty on the prohibition of the stationing of weapons of any kind in outer space [26]. Priority is to be given to negotiating an effective and verifiable ban on anti-satellite systems [27], a subject hitherto reserved for bilateral US–Soviet talks. Moreover, the Committee was requested to complete, during the first part of its session in 1982, the elaboration of a comprehensive programme of disarmament [28].

IV. Promotion of disarmament

The Assembly recommended that a world disarmament campaign should be launched, and that a pledging conference should be held at the United Nations to finance the campaign [29]. In addition, the Assembly expressed the view, with more than one-third of the membership abstaining, that a world-wide collection of signatures in support of measures to prevent nuclear war and to stop the arms race would be an important manifestation of the will of the world public and would contribute to the creation of a favourable climate for achieving progress in the field of disarmament. The Secretary-General was asked to work out the format and methods of conducting such an action under UN auspices [30].

V. Studies

The Assembly took note of several Secretary-General's reports on studies completed in 1981: on Israeli nuclear armament [31], on the relationship between disarmament and development [32], on the relationship between disarmament and international security [33], on confidence-building measures [34], on institutional arrangements relating to the process of disarmament [35], and on a world disarmament campaign [36].

(The study on the establishment of an international satellite monitoring agency (ISMA) [37] was submitted in August 1981 to the Preparatory Committee for the Second Special Session of the General Assembly devoted to disarmament.)

VI. Assessment

Although it adopted a record number of resolutions on arms control, the 1981 UN General Assembly did not break new ground in this field. The atmosphere of increased international tension was not conducive to progress. If anything, the sharp polemics between the USA and the USSR, characterized by mutual cold war accusations of aggressiveness and bad faith, have negatively affected the international arms control endeavours.

Most items, including the studies prepared by experts, have been referred for consideration to the Second Special Session of the General Assembly devoted to disarmament, which is due to take place from 7 June to 9 July 1982.

References

1. UN General Assembly resolution 36/85.
2. UN General Assembly resolution 36/84.
3. UN General Assembly resolution 36/97 I.
4. UN General Assembly resolution 36/86 B.
5. UN General Assembly resolution 36/87 A.
6. UN General Assembly resolution 36/87 B.
7. UN General Assembly resolution 38/88.
8. UN General Assembly resolution 36/90.
9. UN General Assembly resolution 36/83.
10. UN General Assembly resolution 36/92 E.

11. UN General Assembly resolution 36/97 G.
12. UN General Assembly resolution 36/92 K.
13. UN General Assembly resolution 36/95.
14. UN General Assembly resolution 36/92 I.
15. UN General Assembly resolution 36/100.
16. UN General Assembly resolution 36/81 B.
17. UN General Assembly resolution 36/27.
18. UN General Assembly resolution 36/98.
19. UN General Assembly resolution 36/86 A.
20. UN General Assembly resolution 36/96 A.
21. UN General Assembly resolution 36/96 B.
22. UN document A/36/613.
23. UN General Assembly resolution 36/96 C.
24. UN General Assembly resolution 36/97 A.
25. UN General Assembly resolution 36/82 B.
26. UN General Assembly resolution 36/99.
27. UN General Assembly resolution 36/97 C.
28. UN General Assembly resolution 36/92 F.
29. UN General Assembly resolution 36/92 C.
30. UN General Assembly resolution 36/92 J.
31. UN document A/36/431.
32. UN document A/36/356.
33. UN document A/36/597.
34. UN document A/36/474.
35. UN document A/36/392.
36. UN document A/36/458.
37. UN document A/AC.206/14.

Appendix 16A

UN General Assembly resolutions on disarmament, 1981

I. UN member states and year of membership

The following list of names of the 157 UN member states is provided for convenience in reading the record of votes on the UN resolutions listed in section II below.

Afghanistan, 1946
Albania, 1955
Algeria, 1962
Angola, 1976
Antigua and Barbuda, 1981
Argentina, 1945
Australia, 1945
Austria, 1955
Bahamas, 1973
Bahrain, 1971
Bangladesh, 1974
Barbados, 1966
Belgium, 1945
Belize, 1981
Benin, 1960
Bhutan, 1971
Bolivia, 1945
Botswana, 1966
Brazil, 1945
Bulgaria, 1955
Burma, 1948
Burundi, 1962
Byelorussia, 1945
Cameroon, 1960
Canada, 1945
Cape Verde, 1975
Central African Republic, 1960
Chad, 1960
Chile, 1945
China, 1945
Colombia, 1945
Comoros, 1975
Congo, 1960
Costa Rica, 1945
Cuba, 1945
Cyprus, 1960
Czechoslovakia, 1945
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
FR Germany, 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, 1955
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
Saint Lucia, 1979
Saint Vincent and the Grenadines, 1980
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, 1961
Thailand, 1946
Togo, 1960
Trinidad and Tobago, 1962
Tunisia, 1956
Turkey, 1945
Uganda, 1962
UK, 1945
Ukraine, 1945
United Arab Emirates, 1971
Upper Volta, 1960
Uruguay, 1945
USA, 1945
USSR, 1945
Vanuatu, 1981
Venezuela, 1945
Viet Nam, 1977
Yemen Arab Republic, 1947
Yemen, People's Democratic Republic of, 1967
Yugoslavia, 1945
Zaire, 1960
Zambia, 1964
Zimbabwe, 1980

II. Resolutions

Note

This list includes resolutions which exclusively concern disarmament, as well as a few of those which deal with other questions but refer to disarmament matters. In the latter case, the negative votes or abstentions listed do not necessarily reflect the positions of states on the disarmament paragraphs of the relevant resolutions.

Only the essential parts of each resolution are given here. The texts have been abridged, but the wording is close to that of the resolution.

The resolutions are grouped according to disarmament subjects, irrespective of the agenda items under which they were discussed.

Subject, number, date of adoption and contents of the resolution	Voting results
Nuclear weapons	
36/92 E 9 December 1981	
Recalling that, in its resolution 35/152 B of 12 December 1980, it noted with alarm the increased risk of a nuclear catastrophe associated both with the intensification of the nuclear arms race and with the adoption of the new doctrine of limited or partial use of nuclear weapons giving rise to illusions of the admissibility and acceptability of a nuclear conflict; noting with alarm that this dangerous doctrine leads to a new twist in the spiral of the arms race, and convinced that the Committee on Disarmament is the most suitable forum for the preparation and conduct of the negotiations on nuclear disarmament, believes it necessary to initiate, as a matter of high priority, negotiations on the cessation of the production of nuclear weapons and on the gradual reduction of their stockpiles up to and including their total destruction. Deems it appropriate that the Committee on Disarmament should proceed, as the first step, to the consideration of stages of nuclear disarmament and their tentative content, *inter alia* the content of the first stage. Also deems it appropriate to consider, within the framework of the discussion on the content of measures to be carried out during the first stage, the question of the cessation of the development and deployment of new types and systems of nuclear weapons.	*In favour* 118 *Against* 18: Australia, Belgium, Canada, Denmark, France, FR Germany, Iceland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Turkey, UK, USA *Abstaining* 5: Greece, Israel, Mali, Morocco, Zaire *Absent or not participating in the vote*: Albania, Angola,[a] Antigua and Barbuda, Belize, Botswana, China, Comoros, Dominica, Equatorial Guinea, Kampuchea, Malawi, Mauritius, Saint Vincent, Vanuatu,[a] Zimbabwe

36/97 I
9 December 1981

Urges that the process begun by the SALT I Treaty and signature of the SALT II Treaty should continue and be built upon; trusts that the signatory states will continue to refrain from any act which would defeat the object and the purpose of that process; urges the United States and the Soviet Union to pursue negotiations, in accordance with the principle of equality and equal security, looking towards the achievement of an agreement which will provide for substantial reductions and significative qualitative limitations of strategic arms; welcomes the commencement of negotiations at Geneva on 30 November 1981 between representatives of the United States and the Soviet Union on nuclear arms in accordance with the joint communiqué issued by Secretary of State Haig and Foreign Minister Gromyko on 23 September 1981, and trusts that such negotiations will facilitate the enhancement of stability and international security. Invites both governments to keep the General Assembly appropriately informed of the results of their negotiations.

Adopted without vote

36/97 G
9 December 1981

Requests the Committee on Disarmament, at an appropriate stage of its work on the item entitled "Nuclear weapons in all aspects", to pursue its consideration of the question of 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 125
Against 14: Afghanistan, Bulgaria, Byelorussia, Cuba, Czechoslovakia, German Democratic Republic, Hungary, Lao People's Democratic Republic, Mongolia, Poland, Seychelles,[b] Ukraine, USSR, Viet Nam
Abstaining 6: Argentina, Brazil, France, India, UK, USA
Absent or not participating in the vote: Albania, Antigua and Barbuda, Botswana, China, Dominica, Equatorial Guinea, Gambia, Malawi,[a] Mozambique, Saint Vincent, Zimbabwe

36/97 E
9 December 1981

Requests once again the Committee on Disarmament to proceed without delay to talks with a view to elaborating an international agreement on the non-stationing of nuclear weapons on the territories of states where there are no such weapons at present, and calls upon all nuclear weapon states to refrain from further action involving the stationing of nuclear weapons on the territories of other states.

In favour 84
Against 18: Australia, Belgium, Canada, Denmark, France, FR Germany, Iceland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Turkey, UK, USA

Subject, number, date of adoption and contents of the resolution	Voting results
	Abstaining 42: Algeria, Austria, Bahamas, Bangladesh, Belize, Brazil, Burma, Central African Republic, Colombia, Comoros, Costa Rica, Djibouti, Gabon, Ghana, Greece, Guatemala, Haiti, Honduras, Ireland, Israel, Ivory Coast, Kenya, Lebanon, Mauritania, Morocco, Nepal, Pakistan, Papua New Guinea, Paraguay, Peru, Samoa, Senegal, Sierra Leone, Singapore, Somalia, Sri Lanka, Suriname, Sweden, Syria, Tunisia, Yugoslavia, Zaire *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Botswana, China, Dominica, Equatorial Guinea, Gambia, Kampuchea, Malawi,[a] Malta, Saint Vincent, Zimbabwe
36/92 K 9 December 1981 Requests the Committee on Disarmament to start without delay negotiations in an appropriate organizational framework with a view to concluding a convention on the prohibition of the production, stockpiling, deployment and use of nuclear neutron weapons.	*In favour* 68 *Against* 14: Australia, Belgium, Canada, France, FR Germany, Israel, Italy, Japan, Luxembourg, New Zealand, Portugal, Turkey, UK, USA *Abstaining* 57: Argentina, Austria, Bahamas, Bangladesh, Barbados, Brazil, Burma, Cameroon, Central African Republic, Chad, Chile, Colombia, Comoros, Denmark, Djibouti, Egypt, El Salvador, Equatorial Guinea, Fiji, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Haiti, Honduras, Iceland, Ireland, Jamaica, Lebanon, Malaysia, Maldives, Mauritania, Morocco, Nepal, Netherlands, Niger, Norway, Oman, Pakistan, Papua New Guinea, Paraguay, Peru, Saudi Arabia, Singapore, Solomon Islands, Somalia, Spain, Sri Lanka, Sudan, Sweden,

Thailand, Tunisia, Uruguay, Venezuela, Yugoslavia, Zaire
Absent or not participating in the vote: Albania, Antigua and Barbuda, Belize, Bhutan, Bolivia, Botswana, Cape Verde, China, Dominica, Guyana, Kampuchea, Malawi, Mauritius, Saint Vincent, Samoa, Senegal, Zimbabwe

Nuclear tests

36/84
9 December 1981

Reiterates once again its grave concern that nuclear weapon testing continues unabated against the wishes of the overwhelming majority of states; reaffirms its conviction that a treaty to achieve the prohibition of all nuclear test explosions by all states for all time is a matter of the highest priority and constitutes a vital element for the success of efforts to prevent both vertical and horizontal proliferation of nuclear weapons and a contribution to nuclear disarmament; urges all states that have not yet done so to adhere without further delay to the Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water and, meanwhile, to refrain from testing in the environments covered by that Treaty; urges states members of the Committee on Disarmament to support the creation by the Committee, upon initiation of its session in 1982, of an *ad hoc* working group which should begin the multilateral negotiation of a treaty for the prohibition of all nuclear weapon tests; and calls upon the states depositaries of the Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water and the Treaty on the non-proliferation of nuclear weapons, by virtue of their special responsibilities under those two treaties and as a provisional measure, to bring to a halt without delay all nuclear test explosions, either through a trilaterally agreed moratorium or through three unilateral moratoria.

In favour 118
Against 2: UK, USA
Abstaining 23: Australia, Belgium, Belize, Canada, China, Denmark, Fiji, France, FR Germany, Greece, Iceland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Papua New Guinea, Portugal, Samoa, Spain, Turkey, Zambia
Absent or not participating in the vote: Albania, Angola,[a] Antigua and Barbuda, Botswana, Cameroon,[a] Dominica, Kampuchea, Malawi,[a] Mauritius, Nicaragua, Saint Vincent, Vanuatu, Zimbabwe

36/85
9 December 1981

Calls upon the three negotiating nuclear weapon states to resume their negotiations and to exert their best efforts to bring them to an early successful conclusion and invites them to prepare a report on the state of negotiations in good time for submission to the General Assembly at its second special session devoted to disarmament; reiterates its conviction that the Committee on Disarmament has an indispensable role in the negotiation of a treaty prohibiting nuclear testing; requests the Committee to take the necessary steps, including the establishment of a working group, to initiate substantive negotiations on a comprehensive test ban treaty as a matter of the highest priority at the

In favour 140
Against 0
Abstaining 5
(Vote not recorded)

Subject, number, date of adoption and contents of the resolution	Voting results
beginning of its session to be held in 1982; and also requests the Committee to determine, in the context of its negotiations on such a treaty, the institutional and administrative arrangements necessary for establishing, testing and operating an international seismic monitoring network and an effective verification system.	
36/14 28 October 1981	
Requests the UN Scientific Committee on the effects of atomic radiation to continue its work, including its important co-ordinating activities, to increase knowledge of the doses, effects and risks of ionizing radiation from all sources.	Adopted without vote
Non-use of nuclear weapons	
36/92 I 9 December 1981	
Declares once again that: (*a*) the use of nuclear weapons would be a violation of the UN Charter and a crime against humanity; (*b*) the use or threat of use of nuclear weapons should therefore be prohibited, pending nuclear disarmament. Urges the consideration, at the second special session of the General Assembly devoted to disarmament, of the question of an international convention on the non-use of nuclear weapons and prevention of nuclear war or some other agreement on the subject, taking into account the proposals and views of states in this regard.	*In favour* 121 *Against* 19: Australia, Belgium, Canada, Denmark, France, FR Germany, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Turkey, UK, USA *Abstaining* 6: Austria, Comoros, Finland, Greece, Israel, Sweden *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Belize, Botswana, Dominica, Kampuchea, Malawi, Paraguay, Saint Vincent, Zimbabwe
36/100 9 December 1981	
Solemnly proclaims, on behalf of the states members of the United Nations: 1. States and statesmen that resort first to the use of nuclear weapons will be committing the gravest crime against humanity.	*In favour* 82 *Against* 19: Australia, Belgium, Canada, Denmark, France, FR Germany, Iceland, Israel,

2. There will never be any justification or pardon for statesmen who would take the decision to be the first to use nuclear weapons.

3. Any doctrines allowing the first use of nuclear weapons and any actions pushing the world towards a catastrophe are incompatible with human moral standards and the lofty ideals of the United Nations.

4. It is the supreme duty and direct obligation of the leaders of nuclear weapon states to act in such a way as to eliminate the risk of the outbreak of a nuclear conflict. The nuclear arms race must be stopped and reversed by joint effort, through negotiations conducted in good faith and on the basis of equality, having as their ultimate goal the complete elimination of nuclear weapons.

5. Nuclear energy should be used exclusively for peaceful purposes and only for the benefit of mankind.

Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Turkey, UK, USA

Abstaining 41: Argentina, Austria, Bahamas, Bangladesh, Bolivia, Brazil, Burma, Central African Republic, Chile, Comoros, Costa Rica, Egypt, El Salvador, Finland, Gabon, Ghana, Greece, Guatemala, Ireland, Ivory Coast, Kampuchea, Kenya, Liberia, Malaysia, Morocco, Niger, Oman, Papua New Guinea, Paraguay, Rwanda, Samoa, Senegal, Singapore, Solomon Islands, Somalia, Sudan, Sweden, Togo, Trinidad and Tobago, Tunisia, Zaire

Absent or not participating in the vote: Albania, Antigua and Barbuda, Botswana, China, Djibouti, Dominica, Equatorial Guinea, Gambia, Malawi,[b] Saint Vincent, Thailand, Uruguay, Vanuatu, Zimbabwe

36/94
9 December 1981

Calls upon all nuclear weapon states to make solemn declarations, identical in substance, concerning the non-use of nuclear weapons against non-nuclear weapon states having no such weapons on their territories, as a first step towards the conclusion of an international convention, and recommends that the Security Council should examine such declarations and, if they all meet the above-mentioned objective, should adopt an appropriate resolution approving them.

In favour 115

Against 17: Australia, Belgium, Canada, Denmark, FR Germany, Iceland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Turkey, UK, USA

Abstaining 12: Austria, Burma, Greece, Guatemala, India, Ireland, Israel, Japan, Morocco, Sweden, Tunisia, Zaire

Absent or not participating in the vote: Albania, Antigua and Barbuda, Bhutan, Botswana, China, Comoros, Dominica, Kampuchea, Malawi,[a] Saint Vincent, Zambia, Zimbabwe

36/95
9 December 1981

Reaffirms the urgent need to reach agreement on effective international arrangements to assure non-nuclear weapon states against the use or threat of use of nuclear weapons. Appeals to all states,

In favour 145

Against 0

Subject, number, date of adoption and contents of the resolution	Voting results
especially the nuclear weapon states, to demonstrate the political will necessary to reach agreement on a common approach and, in particular, on a common formula which could be included in an international instrument of a legally binding character; and recommends that the Committee on Disarmament should actively continue negotiations with a view to reaching early agreement.	*Abstaining* 3: India, UK, USA *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Bhutan, Botswana, Dominica, Malawi,[a] Saint Vincent, Zimbabwe
36/81 B 9 December 1981	
Urges all nuclear weapon states to submit to the Secretary-General by 30 April 1982, for consideration at the second special session of the General Assembly devoted to disarmament, their views, proposals and practical suggestions for ensuring the prevention of nuclear war.	Adopted without vote
Nuclear weapon-free zones	
36/83 9 December 1981	
Recalling that the United Kingdom and the Netherlands became parties to Additional Protocol I of the Treaty of Tlatelolco in 1969 and 1971, respectively, and noting also that the United States likewise became a party to this Protocol on 23 November 1981, when its instrument of ratification was deposited, regrets that the signature by France, which took place on 2 March 1979, has not yet been followed by the corresponding ratification.	*In favour* 138 *Against* 0 *Abstaining* 5 (Vote not recorded)
36/86 B 9 December 1981	
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.	*In favour* 132 *Against* 0 *Abstaining* 12: Belgium, Canada, France, FR Germany, Guatemala, Israel, Italy, Luxembourg, Netherlands, Portugal, UK, USA *Absent or not participating in the vote*: Angola,[a] Antigua and Barbuda, Botswana, Cameroon,[a] Chile, Dominica, Malawi,[a] Mauritius,[a] Nicaragua, Paraguay, Saint Vincent, Zimbabwe

36/87 A
9 December 1981

Recalling its resolutions 3263 (XXIX) of 9 December 1974, 3474 (XXX) of 11 December 1975, 31/71 of 10 December 1976, 32/82 of 12 December 1977, 33/64 of 14 December 1978, 34/77 of 11 December 1979 and 35/147 of 12 December 1980 on the establishment of a nuclear weapon-free zone in the Middle East, requests the Secretary-General to transmit resolution 35/147 to the Second Special Session Devoted to Disarmament.

Adopted without vote

36/87 B
9 December 1981

Deeply concerned that the future of the Treaty on the non-proliferation of nuclear weapons has been gravely endangered in the Middle East by the attack carried out by Israel, not a party to the Treaty, on the nuclear installations of Iraq, a party to the Treaty, considers that the Israeli attack adversely affects the prospects of the establishment of a nuclear weapon-free zone in the region and declares that it is imperative that Israel place forthwith all its nuclear facilities under IAEA safeguards.

In favour 107
Against 2: Israel, USA
Abstaining 31: Australia, Belgium, Belize, Canada, Central African Republic, Chile, Costa Rica, Denmark, Dominican Republic, Fiji, Finland, France, FR Germany, Guatemala, Haiti, Honduras, Iceland, India, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Papua New Guinea, Paraguay, Solomon Islands, Swaziland, Sweden, UK
Absent or not participating in the vote: Angola,[a] Antigua and Barbuda, Argentina, Bhutan, Bolivia, Botswana, Burma, Cameroon,[a] Dominica, Malawi,[a] Peru,[a] Saint Vincent, Samoa, Uruguay, Vanuatu, Zimbabwe

36/88
9 December 1981

Reaffirms its endorsement, in principle, of the concept of a nuclear weapon-free zone in South Asia; 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 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 co-operation in the efforts to establish such a zone.

In favour 93
Against 3: Bhutan, India, Mauritius
Abstaining 44: Afghanistan, Algeria, Argentina, Australia, Austria, Bahamas, Belize, Benin, Bolivia, Brazil, Bulgaria, Burma, Byelorussia, Cape Verde, Central African Republic, Congo, Cuba, Czechoslovakia, Denmark, Ethiopia, Fiji, France, German Democratic Republic, Grenada, Guinea-Bissau, Hungary, Indonesia, Israel, Italy,

Subject, number, date of adoption and contents of the resolution	Voting results
	Lao People's Democratic Republic, Madagascar, Mongolia, Mozambique, Norway, Poland, Samoa, Sao Tome and Principe, Seychelles, Sweden, Ukraine, UK, USSR, Viet Nam, Yugoslavia *Absent or not participating in the vote*: Albania, Angola,[a] Antigua and Barbuda, Botswana, Cameroon,[a] Comoros, Cyprus, Dominica, Libya, Malawi, Saint Vincent, Suriname, Syria, Vanuatu,[a] Yemen Arab Republic, Zimbabwe
Indian Ocean as a zone of peace	
36/90 9 December 1981	
Convinced that the continued military presence of the great powers in the Indian Ocean area, conceived in the context of their confrontation, gives urgency to the need to take practical steps for the early achievement of the objectives of the Declaration of the Indian Ocean as a zone of peace, regrets that the *Ad Hoc* Committee on the Indian Ocean has failed to reach consensus on the finalization of dates for the convening, during 1981, of a conference on the Indian Ocean; emphasizes its decision to convene the conference, and requests the *Ad Hoc* Committee to continue its work on the necessary harmonization of views on the relevant issues and to make every effort to accomplish the necessary preparatory work for the conference, including consideration of its convening not later than the first half of 1983.	Adopted without vote
Non-proliferation of nuclear weapons	
36/25 11 November 1981	
Commends the IAEA for its continuing efforts to ensure the safe and secure use of nuclear energy for peaceful purposes throughout the world; notes with satisfaction the steady improvement of the IAEA safeguards system and welcomes the conclusion that in 1980, as in previous years, nuclear material under Agency safeguards remained in peaceful nuclear activities or was otherwise ade-	*In favour* 128 *Against* 1: Israel *Abstaining* 4: Guatemala, Jamaica, Malawi, USA

quately accounted for. Urges all states that have not already done so to ratify the Convention on the physical protection of nuclear material, which was opened for signature on 3 March 1980; notes with satisfaction that substantive work has commenced in the Committee on assurances of supply established by the IAEA Board of Governors in June 1980, and expresses the hope that progress in its work will greatly contribute to the success of the UN Conference on the promotion of international co-operation in the peaceful uses of nuclear energy, to be held in 1983. Also notes that there is continuing progress in studies by the IAEA aimed at establishing a system of international storage of plutonium and the international management of spent fuel.

Absent or not participating in the vote: Afghanistan, Angola, Bahamas, Belize, Botswana, Burma, China, Comoros, Congo, Costa Rica, Dominica, Dominican Republic,[b] El Salvador, Gabon, Jordan, Liberia, Mozambique, Papua New Guinea, Saint Vincent, Seychelles, Solomon Islands, Upper Volta

36/86 A
9 December 1981

Deplores the massive build-up of South Africa's military machine, including its acquisition of a nuclear weapon capability; reaffirms that the racist regime's plans and capability in the nuclear field constitute a very grave danger to international peace and security and, in particular, jeopardize the security of African states and increase the danger of the proliferation of nuclear weapons; requests the Security Council to intensify its efforts to prohibit all forms of co-operation and collaboration with the regime of South Africa in the nuclear field and, in particular, to institute effective enforcement action against that regime so as to prevent it from endangering international peace and security through its acquisitions of nuclear weapons; calls upon all states, corporations, institutions and individuals to terminate forthwith all military and nuclear collaboration with the racist regime, including the provision to it of such related materials as computers, electronic equipments and related technology; demands that South Africa submit all its nuclear installations to inspection by the IAEA.

In favour 129
Against 4: France, Israel, UK, USA
Abstaining 10: Australia, Belgium, Canada, FR Germany, Italy, Japan, Luxembourg, Netherlands, New Zealand, Portugal
Absent or not participating in the vote: Angola,[a] Antigua and Barbuda, Botswana, Cameroon,[a] Chile, Dominica, Malawi[a] Mauritius,[a] Nicaragua, Paraguay, Saint Vincent, Vanuatu,[a] Zimbabwe

36/68 (Resolution relating to decolonization matters)
1 December 1981

Having examined the report of the Special Committee on the situation with regard to the implementation of the Declaration on the granting of independence to colonial countries and peoples, strongly condemns all collaboration, particularly in the nuclear and military fields, with the government of South Africa and calls upon the states concerned to cease forthwith all such collaboration. Calls upon the colonial powers to withdraw immediately and unconditionally their military bases and installations from colonial territories and to refrain from establishing new ones.

In favour 130
Against 3: Guatemala, UK, USA
Abstaining 10: Belgium, Canada, France, FR Germany, Israel, Italy, Jamaica, Luxembourg, Rwanda, Saudi Arabia
Absent or not participating in the vote: Antigua and Barbuda, Botswana,[a] Comoros, Dominica, Equatorial Guinea, Guinea-Bissau, Haiti, Jordan,[a] Lesotho,[a] Maldives, Paraguay, Saint Vincent, Yemen Arab Republic

Subject, number, date of adoption and contents of the resolution	Voting results
36/98 9 December 1981 Taking note of the report of the Secretary-General on Israeli nuclear armament, expresses its deep alarm that the report has established that Israel has the technical capability to manufacture nuclear weapons and possesses the means of delivery of such weapons. Requests the Security Council to prohibit all forms of co-operation with Israel in the nuclear field; calls upon all states and other parties and institutions to terminate forthwith all nuclear collaboration with Israel; requests the Security Council to institute effective enforcement action against Israel so as to prevent it from endangering international peace and security by its nuclear weapon capability; and demands that Israel should renounce, without delay, any possession of nuclear weapons and place all its nuclear activities under international safeguards.	*In favour* 101 *Against* 2: Israel, USA *Abstaining* 39: Australia, Austria, Belgium, Belize, Burma, Canada, Central African Republic, Chile, Colombia, Costa Rica, Denmark, Dominican Republic, Fiji, Finland, France, FR Germany, Guatemala, Haiti, Honduras, Iceland, Ireland, Italy, Ivory Coast, Jamaica, Japan, Luxembourg, Nepal, Netherlands, New Zealand, Norway, Papua New Guinea, Paraguay, Portugal, Samoa, Solomon Islands, Swaziland, Sweden, UK, Uruguay *Absent or not participating in the vote*: Antigua and Barbuda, Bolivia, Botswana, Dominica, Equatorial Guinea, Gambia, Liberia,[a] Malawi,[b] Mauritius, Saint Lucia, Saint Vincent, Singapore, Vanuatu, Zimbabwe
36/27 13 November 1981 Expressing its deep alarm over the Israeli act of aggression on the Iraqi nuclear installations on 7 June 1981, recalling Security Council resolution 487 (1981) of 19 June 1981, taking note of the resolution adopted on 12 June 1981 by the IAEA Board of Governors and of resolution GC (XXV)/RES/381 adopted on 26 September 1981 by the General Conference of the Agency, in which the Conference *inter alia* considered that the Israeli act constituted an attack against the Agency and its safeguards regime and decided to suspend the provision of any assistance to Israel, strongly condemns Israel for its premeditated and unprecedented act in violation of the UN Charter and the norms of international conduct; issues a solemn warning to Israel to cease its threats and the commission of such armed attacks against nuclear facilities; reiterates its call to all states to cease forthwith any provision to Israel of arms and related material of all types which enable it to commit	*In favour* 109 *Against* 2: Israel, USA *Abstaining* 34: Argentina, Australia, Austria, Bahamas, Belgium, Bolivia, Canada, Chile, Colombia, Costa Rica, Denmark, Dominican Republic, El Salvador, Fiji, Finland, France, FR Germany, Guatemala, Haiti, Honduras, Iceland, Ireland, Italy, Japan, Luxembourg, Malawi, Netherlands, New Zealand, Norway, Papua New Guinea, Paraguay, Sweden, UK, Zaire

acts of aggression against other states and demands that Israel pay prompt and adequate compensation for the material damage and loss of life suffered as a result of the said act.

Absent or not participating in the vote: Angola, Antigua and Barbuda, Belize, Botswana, Burma, Dominica, Iran, Jamaica, Saint Lucia, Saint Vincent, Solomon Islands

Chemical weapons

36/96 A
9 December 1981

Expresses its regret that an agreement on the complete and effective prohibition of the development, production and stockpiling of all chemical weapons and on their destruction has not yet been elaborated and urges the Committee on Disarmament to continue, as from the beginning of its session in 1982, negotiations on such a multilateral convention as a matter of high priority.

In favour 147
Against 0
Abstaining 1: USA
Absent or not participating in the vote: Albania, Antigua and Barbuda, Botswana, Dominica, Gambia, Malawi,[a] Saint Vincent, Zimbabwe

36/96 B
9 December 1981

Expressing profound concern over the production of new types of chemical weapons and other actions which would intensify the chemical arms race, urges the Committee on Disarmament to continue negotiations on a multilateral convention and calls upon the USSR and the USA to resume at the earliest possible date bilateral negotiations on the prohibition of the development, production and stockpiling of all chemical weapons and on their destruction and to submit their joint initiative to the Committee on Disarmament. Calls upon all states to refrain from any action which could impede negotiations on the prohibition of chemical weapons and specifically to refrain from production and deployment of binary and other new types of chemical weapons, as well as from stationing chemical weapons in those states where there are no such weapons at present.

In favour 109
Against 1: USA
Abstaining 33: Argentina, Australia, Austria, Belgium, Belize, Canada, Central African Republic, Denmark, Finland, France, FR Germany, Greece, Guatemala, Honduras, Iceland, Ireland, Israel, Italy, Ivory Coast, Japan, Luxembourg, Netherlands, New Zealand, Niger, Norway, Paraguay, Portugal, Spain, Sweden, Turkey, UK, Upper Volta, Zaire
Absent or not participating in the vote: Albania, Antigua and Barbuda, Botswana, China, Dominica, Gambia, Kampuchea, Lebanon, Malawi,[a] Malta, Peru,[a] Saint Vincent, Zimbabwe

36/96 C
9 December 1981

Taking note of the report of the Secretary-General with the annexed report prepared by the Group of Experts to investigate the alleged use of chemical weapons; noting that the Group has not yet completed the investigations; noting also the views of the Group concerning the importance of

In favour[c] 86
Against 20: Afghanistan, Bulgaria, Byelorussia, Congo, Cuba, Czechoslovakia, Ethiopia,

Subject, number, date of adoption and contents of the resolution	Voting results
prompt on-site investigation of allegations of the use of chemical weapons and the need to devise appropriate procedures for impartial collection and analysis of samples that may be obtained in the course of any such investigations, requests the Secretary-General, with the assistance of the Group to continue his investigations.	German Democratic Republic, Hungary, Lao People's Democratic Republic, Mongolia, Mozambique, Poland, Romania, Seychelles, Syria, Ukraine, USSR, Viet Nam, Yemen (People's Democratic Republic of) *Abstaining* 34: Argentina, Bahrain, Bhutan, Brazil, Burma, Burundi, Cameroon, Cape Verde, Finland, Guinea, Guinea-Bissau, Haiti,[b] India, Indonesia, Iraq, Kuwait, Lebanon, Madagascar, Mali, Malta, Mexico, Nepal, Nicaragua, Panama, Peru, Qatar, Sri Lanka, Tanzania, Trinidad and Tobago, Uganda, United Arab Emirates, Venezuela, Yemen Arab Republic, Yugoslavia *Absent or not participating in the vote*: Albania, Algeria, Angola, Antigua and Barbuda, Benin, Botswana, Cyprus, Dominica, Gambia, Grenada, Iran, Libya, Malawi,[b] Saint Vincent, Sao Tome and Principe, Zimbabwe
Radiological weapons	
36/97 B 9 December 1981	
Calls upon the Committee on Disarmament to continue negotiations with a view to an early conclusion of the elaboration of a treaty prohibiting the development, production, stockpiling and use of radiological weapons, in order that it may be submitted, if possible, to the General Assembly at its second special session devoted to disarmament.	Adopted without vote
New weapons of mass destruction	
36/89 9 December 1981	
Requests the Committee on Disarmament, in the light of its existing priorities, to intensify negotiations, with the assistance of qualified governmental experts, with a view to preparing a draft	*In favour* 116 *Against* 0

comprehensive 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 draft possible agreements on particular types of such weapons. Urges all states to refrain from any action which could adversely affect the talks aimed at working out such agreements and calls upon the states permanent members of the Security Council, as well as other militarily significant states, to make declarations, identical in substance, concerning the refusal to create new types of weapons of mass destruction and new systems of such weapons, as a first step towards the conclusion of a comprehensive agreement on this subject, bearing in mind that such declarations would be approved thereafter by a decision of the Security Council.

Abstaining 27: Australia, Austria, Belgium, Canada, Colombia, Denmark, France, FR Germany, Ghana, Greece, Guatemala, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Swaziland, Sweden, Turkey, UK, USA
Absent or not participating in the vote: Albania, Angola,[a] Antigua and Barbuda, Botswana, Cameroon,[a] China, Comoros, Dominica, Kampuchea, Malawi, Saint Vincent, Vanuatu,[a] Zimbabwe

Conventional weapons

36/93
9 December 1981

Urges those states which have not yet done so to exert their best endeavours to sign and ratify the Convention on prohibitions or restrictions on the use of certain conventional weapons which may be deemed to be excessively injurious or to have indiscriminate effects, and the protocols annexed thereto, as early as possible, so as to obtain the entry into force of the convention and, ultimately, universal adherence to it.

Adopted without vote

36/188 (Resolution relating to the protection of the environment)
17 December 1981

Reiterates its support for the demand of the states affected by the implantation of mines and the presence of other remnants of war on their lands for compensation for the losses incurred from the states responsible for those remnants.

In favour 115[d]
Against 0
Abstaining 29: Australia, Austria, Belgium, Canada, Denmark, Finland, France, FR Germany, Greece, Iceland, Ireland, Israel, Italy, Ivory Coast, Japan, Luxembourg, Malawi, Morocco, Netherlands, New Zealand, Niger, Norway, Portugal, Senegal, Spain, Sweden, UK, Upper Volta, USA
Absent or not participating in the vote: Antigua and Barbuda, Belize, Chad, Comoros, Dominica, Equatorial Guinea, Saint Vincent, Seychelles, Singapore, Solomon Islands, Sri Lanka, Tanzania

Subject, number, date of adoption and contents of the resolution	Voting results
36/97 A 9 December 1981 Recalling its resolution 35/156 A of 12 December 1980 in which it approved, in principle, the carrying out of a study on all aspects of the conventional arms race and on disarmament relating to conventional weapons and armed forces, to be undertaken by the Secretary-General with the assistance of a group of qualified experts appointed by him on a balanced geographical basis; and recalling the discussions at the 1981 session of the Disarmament Commission on the general approach, scope and structure of the study, requests the Secretary-General to establish the group of experts in accordance with the provisions of resolution 35/156 A; requests the Disarmament Commission at its session in 1982 to complete its consideration of the general approach to the study, its structure and scope and to transmit the conclusions of its deliberations to the group of experts; and agrees that the group of experts should pursue its work after the session of the Disarmament Commission.	*In favour* 114 *Against* 0 *Abstaining* 26: Afghanistan, Bahrain, Benin, Bulgaria, Byelorussia, Cuba, Czechoslovakia, German Democratic Republic, Grenada, Hungary, India, Iraq, Jordan, Kuwait, Lao People's Democratic Republic, Mongolia, Mozambique, Poland, Qatar, Sao Tome and Principe, Seychelles, Ukraine, United Arab Emirates, USSR, Viet Nam, Yemen (People's Democratic Republic of) *Absent or not participating in the vote*: Albania, Algeria, Antigua and Barbuda, Botswana, Dominica, Dominican Republic, Equatorial Guinea, Ethiopia, Gambia, Iran, Lebanon, Libya, Malawi,[a] Saint Vincent, Syria, Zimbabwe
Regional disarmament	
36/97 H 9 December 1981 Requests the Secretary-General to submit the study on all the aspects of regional disarmament and his report containing the views of member states to the General Assembly at its second special session devoted to disarmament.	Adopted without vote
Military expenditures	
36/82 A 9 December 1981 Reaffirms the urgent need to reinforce the endeavours of all states and international action in the area of the reduction of military budgets, with a view to reaching international agreements to freeze, reduce or otherwise restrain military expenditures; reiterates the appeal to all states, in particular	Adopted without vote

the most heavily armed states, pending the conclusion of agreements on the reduction of military expenditures, to exercise self-restraint in their military expenditures with a view to reallocating the funds thus saved to economic and social development, particularly for the benefit of developing countries; requests the Disarmament Commission to continue at its session to be held in 1982 the consideration of the item entitled "Reduction of military budgets".

36/82 B
9 December 1981

Considering that the activities related to the reporting of military expenditures as well as to the questions of comparability and verification and other ongoing activities within the framework of the United Nations related to the question of the reduction of military budgets should be regarded as having the fundamental objective of reaching international agreements on the reduction of military expenditures, stresses the need of increasing the number of reporting states with a view to the broadest possible participation from different geographic regions and representing different budgeting systems; reiterates its recommendation that all member states should make use of the reporting instrument and report annually, by 30 April, to the Secretary-General their military expenditures of the latest fiscal year for which data are available; and requests the Secretary-General to examine ways and means to make the collection and assembling of data on military expenditures, reported by states on the basis of the reporting instrument, an integral part of the regular UN statistical services and to arrange and publish these data according to statistical practice.

In favour 120
Against 0
Abstaining 19
(Vote not recorded)

Outer space

36/97 C
9 December 1981

Urges all states, in particular those with major space capabilities, to contribute actively to the goal of preventing an arms race in outer space and to refrain from any action contrary to that aim; requests the Committee on Disarmament to consider, as from the beginning of its session in 1982, the question of negotiating effective and verifiable agreements aimed at preventing an arms race in outer space, taking into account all existing and future proposals designed to meet this objective; and requests the Committee to consider as a matter of priority the question of negotiating an effective and verifiable agreement to prohibit anti-satellite systems, as an important step towards the fulfilment of the objectives set out above.

In favour 129
Against 0
Abstaining 13: Afghanistan, Bulgaria, Byelorussia, Cuba, Czechoslovakia, German Democratic Republic, Hungary, Lao People's Democratic Republic, Mongolia, Poland, Ukraine, USSR, Viet Nam
Absent or not participating in the vote: Albania, Antigua and Barbuda, Botswana, Burma, Dominica, Equatorial Guinea, Gambia, Ghana, Malawi,[a] Mozambique, Saint Vincent, Sao Tome and Principe, Syria, Zimbabwe

Subject, number, date of adoption and contents of the resolution	Voting results
36/99 9 December 1981 Taking into account the draft treaty on the prohibition of the stationing of weapons of any kind in outer space, submitted to the General Assembly by the USSR, and the views and comments expressed during the consideration of that item at the thirty-sixth session, considers it necessary to take effective steps, by concluding an appropriate international treaty, to prevent the spread of the arms race to outer space and requests the Committee on Disarmament to embark on negotiations with a view to achieving agreement on the text of such a treaty.	*In favour* 123 *Against* 0 *Abstaining* 21: Australia, Belgium, Canada, Denmark, France, FR Germany, Greece, Iceland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Tunisia, Turkey, UK, USA *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Botswana, Burma, Dominica, Equatorial Guinea, Gambia, Kampuchea, Malawi,[a] Saint Vincent, Vanuatu, Zimbabwe
Disarmament and international security	
36/97 K 9 December 1981 Aware that the rational means for the security of nations is to move towards a halt in the arms race by developing in a parallel way the measures and modalities for collective security as mandatorily required by the UN Charter, calls upon all states to take prompt action for the implementation of General Assembly resolution 35/156 J of 12 December 1980, which would render effective the decisions of the Security Council in accordance with the UN Charter and thereby be conducive to meaningful disarmament negotiations. Deems it necessary, as a first step in this direction, that the Security Council take the required measures towards the implementation of Chapter VII of the Charter, which would reinforce the foundations of peace, security and order through the United Nations and avert the growing threat of nuclear conflagration.	*In favour* 132 *Against* 0 *Abstaining* 11: Belgium, China, France, FR Germany, Italy, Luxembourg, Netherlands, New Zealand, Portugal, UK, USA *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Botswana, Dominica, Equatorial Guinea, Gambia, Haiti, Lebanon, Malawi,[a] Saint Vincent, Turkey, Vanuatu. Zimbabwe
36/97 L 9 December 1981 Notes the study on the relationship between disarmament and international security prepared by the Secretary-General; commends the study and its conclusions to the attention of all member states; and invites states to inform the Secretary-General, no later than 15 April 1982, of their views regarding the study.	Adopted without vote

Disarmament and development

36/92 G
9 December 1981

Welcomes the report of the Secretary-General and the study on the relationship between disarmament and development contained therein; commends the report, its conclusions and recommendations to the attention of all member states; invites states to inform the Secretary-General, no later than 15 April 1982, of their views regarding the report and, in particular, its recommendations; and decides to transmit the report to the General Assembly at its second special session devoted to disarmament for its substantive consideration and appropriate action.

Adopted without vote

Confidence-building measures

36/97 F
9 December 1981

Takes note of the comprehensive study on confidence-building measures prepared by the Secretary-General; recognizes that confidence reflects a set of interrelated factors of a military as well as of a non-military character and that a plurality of approaches is needed to overcome fear, apprehension and mistrust between states and to replace them by confidence; believes that the promotion of confidence-building measures where appropriate conditions exist will significantly contribute to facilitating the process of disarmament; and invites all states to consider the possible introduction of confidence-building measures in their particular regions and, where possible, to negotiate on them in keeping with conditions and requirements prevailing in the respective regions.

Adopted without vote

Disarmament machinery

39/92 F
9 December 1981

Urges the Committee on Disarmament to continue or undertake, during its session to be held in 1982, substantive negotiations on the priority questions of disarmament on its agenda, in accordance with the provisions of the Final Document of the Tenth Special Session of the General Assembly and other relevant resolutions of the Assembly; to provide the existing *ad hoc* working groups with appropriate negotiating mandates and to establish, as a matter of urgency, *ad hoc* working groups on the cessation of the nuclear arms race and nuclear disarmament and on the prohibition of all nuclear weapon tests. Requests the Committee to complete, during the first part of its session in 1982, the elaboration of a comprehensive programme of disarmament and to submit the programme

In favour 136
Against 0
Abstaining 9: Belgium, Canada, France, FR Germany, Italy, Japan, Luxembourg, UK, USA
Absent or not participating in the vote: Albania, Angola,[a] Antigua and Barbuda, Belize, Botswana, Dominica, Equatorial Guinea, Malawi, Saint Vincent, Vanuatu,[a] Zimbabwe

Subject, number, date of adoption and contents of the resolution	Voting results
in time for consideration and adoption by the General Assembly at its second special session devoted to disarmament. Also invites the members of the Committee involved in separate negotiations on specific questions to intensify their efforts to achieve a positive conclusion of those negotiations and to submit to the Committee a full report.	
36/97 J 9 December 1981 Recommends that the first review of the membership of the Committee on Disarmament should be completed, following appropriate consultation among member states, during the next special session of the General Assembly devoted to disarmament; and reaffirms that states not members of the Committee should upon their request continue to be invited to participate in the work of the Committee.	*In favour* 134 *Against* 0 *Abstaining* 12: Afghanistan, Bulgaria, Byelorussia, Czechoslovakia, German Democratic Republic, Hungary, Lao People's Democratic Republic, Mongolia, Poland, Ukraine, USSR, Viet Nam. *Absent or not participating in the vote*: Albania, Antigua and Barbuda, Botswana, Dominica, Equatorial Guinea, Gambia, Malawi,[a] Mozambique, Saint Vincent, Zimbabwe
36/92 M 9 December 1981 Expresses its deep concern about the continued arms race, in particular the nuclear arms race, as well as about the constantly growing military budgets; urgently calls upon all states, in particular nuclear weapon states and other major military powers, immediately to take steps in order to promote international security and lead to the effective halting and reversing of the arms race and to disarmament; urges those states also to intensify their efforts to bring to a successful end the negotiations which are currently taking place in the Committee on Disarmament; and invites states which are engaged in disarmament and/or arms limitation negotiations outside the UN framework to keep the General Assembly and the Committee on Disarmament informed of the results of such negotiations.	Adopted without vote
36/92 B 9 December 1981 Requests the Disarmament Commission to continue its work in accordance with its mandate and to submit a substantive report to the General Assembly at its second special session devoted to disarmament.	Adopted without vote

36/91
9 December 1981

Notes that in its report to the General Assembly the *Ad Hoc* Committee on the World Disarmament Conference stated *inter alia* the following: "Having regard for the important requirements of a world disarmament conference to be convened at the earliest appropriate time, with universal participation and with adequate preparation, the General Assembly may wish to decide that, after its second special session devoted to disarmament, a world disarmament conference would take place as soon as the necessary consensus on its convening has been reached". Renews the mandate of the *Ad Hoc* Committee and requests it to maintain close contact with the representatives of the states possessing nuclear weapons in order to remain currently informed of their attitudes, as well as with all other states, and to consider any possible relevant proposals and observations which might be made to the Committee.

Adopted without vote

36/97 D
9 December 1981

Having considered the report of the Secretary-General with the annexed study prepared by the group of governmental experts on the institutional arrangements relating to the process of disarmament, invites all member states to transmit to the Secretary-General by 31 March 1982 their comments on the study and its conclusions and recommendations; requests the Secretary-General to transmit the study to the Committee on Disarmament; and decides to transmit the report and the comments to the General Assembly at its second special session devoted to disarmament for substantive consideration and adoption of appropriate decisions.

Adopted without vote

36/81 A
9 December 1981

Endorses the report of the Preparatory Committee for the second special session of the General Assembly devoted to disarmament, to be held between 7 June and 9 July 1982 at UN Headquarters in New York; also endorses the recommendation of the Preparatory Committee to meet in New York for the period 26 April–14 May 1982 in order to continue consideration of substantive issues, including the implementation of the decisions and recommendations adopted by the General Assembly at its tenth special session, for incorporation in the document or documents to be adopted at the second special session on disarmament and any remaining matters. Invites member states to submit to the Secretary-General, not later than 31 March 1982, further views on the substantive issues related to the special session, and requests states engaged in bilateral, regional or multilateral negotiations on disarmament issues, outside the framework of the United Nations, to submit appropriate information on such negotiations to the General Assembly.

Adopted without vote

Subject, number, date of adoption and contents of the resolution	Voting results
36/92 D 9 December 1981 Calls upon member states to refrain from any action that could hamper, complicate or render impossible the disarmament negotiations which are under way, the opening of new negotiations or the achievement of specific disarmament agreements and, in particular, not to hinder possible progress in negotiations on disarmament by the discussion of unrelated issues.	*In favour* 116 *Against* 0 *Abstaining* 26: Australia, Austria, Belgium, Canada, Denmark, Finland, France, FR Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Turkey, UK, USA, Zaire *Absent or not participating in the vote*: Albania, Angola,[a] Antigua and Barbuda, Belize, Botswana, China, Comoros, Dominica, Equatorial Guinea, Kampuchea, Malawi, Saint Vincent, Vanuatu,[a] Zimbabwe
Information, research and training	
36/92 C 9 December 1981 Notes the contents of the study on the World Disarmament Campaign and commends its conclusions. Invites all member states to transmit to the Secretary-General, not later than 15 April 1982, the suggestions and comments which they deem appropriate to formulate for the implementation of the recommendations contained in the study; and requests the Secretary-General to transmit to the General Assembly at its second special session devoted to disarmament both the study and the opinions thereon in order that the Assembly may take the decisions it considers advisable for the solemn launching of the Campaign, including a pledging conference to take place at the initial state of the special session.	*In favour* 143 *Against* 0 *Abstaining* 2: Israel, USA *Absent or not participating in the vote*: Albania, Angola,[a] Antigua and Barbuda, Belize, Botswana, Comoros, Dominica, Equatorial Guinea, Malawi, Saint Vincent, Zimbabwe
36/92 J 9 December 1981 Invites member states to communicate to the Secretary-General their views and suggestions concerning world-wide action for collecting signatures in support of measures to prevent nuclear war, to curb the arms race and for disarmament and requests the Secretary-General to prepare a report on	*In favour* 78 *Against* 3: Brazil, Canada, USA *Abstaining* 56: Argentina, Australia, Austria,

the most appropriate format and methods of carrying out such world-wide action under the auspices of the United Nations.

Bahamas, Belgium, Bhutan, Central African Republic, Colombia, Comoros, Denmark, Ecuador, Egypt, Equatorial Guinea, Fiji, Finland, France, Gabon, FR Germany, Ghana, Greece, Haiti, Honduras, Iceland, India, Ireland, Israel, Italy, Ivory Coast, Luxembourg, Malaysia, Maldives, Nepal, Netherlands, New Zealand, Niger, Nigeria, Norway, Oman, Pakistan, Papua New Guinea, Paraguay, Portugal, Singapore, Solomon Islands, Somalia, Spain, Sri Lanka, Sudan, Sweden, Togo, Tunisia, Turkey, United Arab Emirates, UK, Yugoslavia, Zaire

Absent or not participating in the vote: Albania, Algeria, Antigua and Barbuda, Bangladesh,[b] Belize, Botswana, Burma, China, Dominica, Kampuchea, Libya, Malawi, Mauritania, Saint Vincent, Samoa, Senegal, Suriname, Vanuatu,[a] Zimbabwe

36/92 H
9 December 1981

Reaffirms the importance of the universality of multilateral disarmament agreements; request states depositaries of the agreements to furnish the Secretary-General with information regarding their status by the beginning of each regular session of the General Assembly; and further requests the Secretary-General to prepare for each session a composite table of signatories of and parties to such agreements.

In favour 115
Against 0
Abstaining 23: Argentina, Australia, Austria, Belgium, Brazil, Denmark, France, FR Germany, Iceland, India, Israel, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Turkey, UK, Uruguay, USA

Absent or not participating in the vote: Albania, Algeria, Angola,[a] Antigua and Barbuda, Belize, Botswana, Burma, China, Comoros, Dominica, Equatorial Guinea, Iran, Kampuchea, Libya, Malawi, Saint Vincent, Syria, Zimbabwe

36/92 L
9 December 1981

Taking note of the report of the Secretary-General on the work of the Advisory Board on disarmament studies in 1981, requests the Secretary-General to submit this report to the General Assembly at its second special session devoted to disarmament for its further consideration.

Adopted without vote

Subject, number, date of adoption and contents of the resolution	Voting results
36/92 A 9 December 1981 Decides to continue the UN programme of fellowships on disarmament, and requests the Secretary-General to submit to the General Assembly at its second special session devoted to disarmament a report containing an assessment of the programme since its inception in 1979.	Adopted without vote

[a] Later advised the Secretariat it had intended to vote in favour.
[b] Later advised the Secretariat it had intended to abstain.
[c] Vanuatu later advised the Secretariat it had intended to abstain.
[d] Somalia later advised the Secretariat it had intended to abstain.

17. Multilateral and bilateral arms control agreements[1]

The main undertakings which have been assumed by states in the arms control agreements concluded by 31 December 1981 include: (*a*) restrictions on nuclear weapon testing; (*b*) strategic arms limitations; (*c*) the non-proliferation of nuclear weapons; (*d*) the prohibition of non-nuclear weapons of mass destruction; (*e*) the demilitarization, denuclearization and other measures of restraint in certain environments or geographical areas; (*f*) the prevention of war; and (*g*) the humanitarian laws of war.

This chapter contains appropriately annotated summaries of these agreements.[2]

I. Restrictions on nuclear weapon testing

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

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.

Only three nuclear weapon powers—the UK, the USA and the USSR—are parties to the PTBT. China and France have refused to adhere to it, but France stopped atmospheric tests in 1975.

[1] The term 'arms control' is used here in a broad sense to denote measures intended to freeze, limit or abolish specific categories of weapons; to prevent certain military activities; to proscribe transfers of militarily important items; to reduce the risk of war; to constrain or prohibit the use of certain arms in war; or to build up confidence among states through greater openness in the military field. It thus includes measures of both arms limitation and disarmament.

[2] For the full texts of arms control agreements and the status of their implementation, see Goldblat, J., *Agreements for Arms Control: A Critical Survey* (Taylor & Francis, London, 1982, Stockholm International Peace Research Institute).

Treaty between the USA and the USSR 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 1981

Prohibits from 31 March 1976 the carrying out of any underground nuclear weapon test having a yield exceeding 150 kt. 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.

Treaty between the USA and the USSR 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 1981

Prohibits the carrying out of any individual underground nuclear explosion for peaceful purposes, having a yield exceeding 150 kt, or any group explosion (consisting of two or more individual explosions) with an aggregate yield exceeding 1 500 kt. 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 kt 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 access to sites of explosions in certain specified cases. 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.

In 1977 the UK, the USA and the USSR started trilateral talks for the achievement of a comprehensive test ban treaty (CTBT). In 1980 these talks were adjourned *sine die.*

II. Strategic arms limitations

SALT I

Treaty between the USA and the USSR on the limitation of anti-ballistic missile systems (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 an intercontinental ballistic missile (ICBM) complex. 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.

Protocol to the US–Soviet ABM Treaty

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 ABM Treaty. 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 the signing of 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.

Interim Agreement between the USA and the USSR on certain measures with respect to the limitation of strategic offensive arms

Signed at Moscow on 26 May 1972; entered into force on 3 October 1972

Provides for a freeze for a period of five years of the aggregate number of fixed land-based intercontinental ballistic missile (ICBM) 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.

Memorandum of Understanding between the USA and the USSR regarding the establishment of a Standing Consultative Commission on arms limitation

Signed at Geneva on 21 December 1972; entered into force on 21 December 1972

Establishes a Standing Consultative Commission (SCC) to promote the objectives and implementation of the provisions of the ABM Treaty and Interim Agreement of 26 May 1972, and of the Nuclear Accidents Agreement of 30 September 1971 (see below). 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.

A *Protocol* establishing regulations governing the procedures and other relevant matters of the SCC was signed on 30 May 1973 and entered into force on the same day.

SALT II

Treaty between the USA and the USSR on the limitation of strategic offensive arms (SALT II Treaty)

Signed at Vienna on 18 June 1979; not in force by 31 December 1981

Sets, for both parties, an initial ceiling of 2 400 on intercontinental ballistic missile (ICBM) launchers, submarine-launched ballistic missile (SLBM) launchers, heavy bombers, and air-to-surface ballistic missiles (ASBMs) capable of a range in excess of 600 km. This ceiling will be lowered to 2 250 and the lowering must begin on 1 January 1981, while the dismantling or destruction of systems which exceed that number must be completed by 31 December 1981. A sublimit of 1 320 is imposed upon each party for the combined number of launchers of ICBMs and SLBMs equipped with multiple independently targetable re-entry vehicles (MIRVs), ASBMs equipped with MIRVs, and aeroplanes equipped for long-range (over 600 km) cruise missiles. Moreover, each party is limited to a total of 1 200 launchers of MIRVed ICBMs and SLBMs, and MIRVed ASBMs, and of this number no more than 820 may be launchers of MIRVed ICBMs. A freeze is introduced on the number of re-entry vehicles on current types of ICBMs, with a limit of 10 re-entry vehicles on the one new type of ICBM allowed each side, a limit of 14 re-entry vehicles on SLBMs and a limit of 10 re-entry vehicles on ASBMs. An average of 28 long-range air-launched cruise missiles (ALCMs) per heavy bomber is allowed, while current heavy bombers may carry no more than 20 ALCMs each. Ceilings are established on the throw-weight and launch-weight of light and heavy ICBMs. There are the following bans: on the testing and deployment of new types of ICBMs, with one exception for each side; on building additional fixed

ICBM launchers; on converting fixed light ICBM launchers into heavy ICBM launchers; on heavy mobile ICBMs, heavy SLBMs, and heavy ASBMs; on surface-ship ballistic missile launchers; on systems to launch missiles from the sea-bed or the beds of internal waters; as well as on systems for delivery of nuclear weapons from Earth orbit, including fractional orbital missiles. National technical means will be used to verify compliance. Any interference with such means of verification, or any deliberate concealment measures which impede verification, are prohibited. The Treaty is to remain in force until 31 December 1985.

Prior to the signing of the Treaty, on 16 June 1979, the USSR informed the USA that the Soviet 'Tu-22M' aircraft, called 'Backfire', is a medium-range bomber, and that the Soviet Union does not intend to give this bomber an intercontinental capability and will not increase its radius of action to enable it to strike targets on US territory. The USSR also pledged to limit the production of Backfire aircraft to the 1979 rate.

Protocol to the SALT II Treaty

Signed at Vienna on 18 June 1979; not in force by 31 December 1981

Bans until 31 December 1981: the deployment of mobile ICBM launchers or the flight-testing of ICBMs from such launchers; the deployment (but not the flight-testing) of long-range cruise missiles on sea-based or land-based launchers; the flight-testing of long-range cruise missiles with multiple warheads from sea-based or land-based launchers; and the flight-testing or deployment of ASBMs. The Protocol is an integral part of the Treaty.

The SALT II Treaty and the Protocol are accompanied by agreed statements and common understandings clarifying the obligations under particular articles.

In a **Memorandum of Understanding** the parties agreed on the numbers of strategic offensive arms in each of the 10 categories limited by the Treaty, as of 1 November 1978. In separate statements of data, each party declared that it possessed the stated number of strategic offensive arms subject to the Treaty limitations as of the date of signature of the Treaty.

Joint Statement by the USA and the USSR of principles and basic guidelines for subsequent negotiations on the limitation of strategic arms

Signed at Vienna on 18 June 1979

States that the parties will pursue the objectives of significant and substantial reductions in the numbers of strategic offensive arms, qualitative limitations on these arms, and resolution of the issues included in the Protocol to the SALT II Treaty. To supplement national technical means of verification, the parties may employ, as appropriate, co-operative measures.

As announced by the US Secretary of State, new strategic arms negotiations were to begin in the spring of 1982. In the meantime, on 30 November 1981, the United States and the Soviet Union started meeting in Geneva to conduct "intermediate nuclear force negotiations", as they were called by the USA, or "talks on the reduction of nuclear arms in Europe" as they were called by the USSR.

III. Non-proliferation of nuclear weapons

Treaty on the non-proliferation of nuclear weapons (NPT)

Signed at London, Moscow and Washington on 1 July 1968; entered into force on 5 March 1970

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.

The structure and content of agreements between the IAEA and states required in connection with the NPT were agreed to in 1971. Pursuant to a safeguards agreement, the IAEA also concludes subsidiary arrangements which contain technical and operational details.

Of the five nuclear weapon powers, France and China have not adhered to the NPT. However, France stated that it would behave as a state adhering to the Treaty and that it would follow a policy of strengthening the safeguards relating to nuclear equipment, material and technology. Of the non-nuclear weapon states, India (not a signatory of the NPT) exploded in 1974 a nuclear device which it claimed to be for peaceful purposes.

In 1977 a group of major nuclear suppliers (the so-called London Club), comprising 15 countries, agreed on a set of guidelines for nuclear transfers.

Conferences of the parties to the NPT reviewing the implementation of the Treaty were held in 1975 and 1980.

Convention on the physical protection of nuclear material

Signed at Vienna and New York on 3 March 1980; not in force by 31 December 1981

Obliges the parties to ensure that, during international transport across their territory or on ships or planes under their jurisdiction, nuclear material for peaceful purposes as categorized in a special annex is protected at the agreed level. Storage of such material, incidental to international transport, must be within an area under constant surveillance. Robbery and embezzlement or extortion in relation to nuclear material, and acts without lawful authority involving nuclear material, are to be treated as punishable offences. "International nuclear transport" is defined as the carriage of a consignment of nuclear material by any means of transport intended to go beyond the territory of the state where the shipment originates.

UN Security Council Resolution on security assurances to non-nuclear weapon states

Adopted on 19 June 1968

Provides for immediate assistance by the UK, the USA and the USSR, in conformity with the UN Charter, to be given to any non-nuclear weapon state party to the NPT which is a victim of an act or an object of a threat of aggression in which nuclear weapons are used.

At the 1978 UN Special Session on Disarmament the USSR declared that it 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. The USA announced that it 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, except in the case of an attack on the USA or its allies by a non-nuclear weapon state allied to or associated with a nuclear weapon state in carrying out or sustaining the attack. A similar statement was issued by the UK. Since then, the Committee on Disarmament has discussed ways of developing a uniform formula of security assurances to be incorporated in an international legal instrument.

IV. Prohibition of non-nuclear weapons of mass destruction

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

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.

The 1980 Conference reviewing the operation of the BW Convention reaffirmed the comprehensive nature of the prohibitions under the BW Convention by stating that the language of the Convention fully covered all agents which could result from the application of such new techniques as the techniques for manipulation of molecules which form the genetic material of organisms.

The parties to the BW Convention recognized that the Convention was only a step towards an agreement effectively prohibiting also chemical weapons and providing for their destruction. Consequently, the prohibition of chemical means of warfare has been the subject of discussions in the Committee on Disarmament, as well as of bilateral talks between the USA and the USSR.

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

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.

The understandings reached during the negotiations, but not written into the Convention, define the terms "widespread", "long-lasting" and "severe".

Since 1979, the Committee on Disarmament has been discussing the prohibition of radiological weapons, defined as any device other than a nuclear explosive device, specifically designed to employ radioactive material by disseminating it to cause destruction, damage or injury by means of the radiation produced by the decay of such material, as well as any radioactive material, other than that produced by a nuclear explosive device, specifically designed for such use.

V. Demilitarization, denuclearization and other measures of restraint in certain environments or geographical areas

Antarctic Treaty

Signed at Washington on 1 December 1959; entered into force on 23 June 1961

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.

Representatives of the contracting parties meet at regular intervals to exchange information and consult each other on matters of common interest pertaining to Antarctica, as well as to recommend to their governments measures in furtherance of the principles and objectives of the Treaty.

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 1967; entered into force on 10 October 1967

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.

A separate **Agreement governing the activities of states on the Moon and other celestial bodies** was opened for signature on 18 December 1979. By 31 December 1981 it was not yet in force.

In 1981 the Soviet Union proposed a treaty which would prohibit the stationing of weapons of any kind in outer space, including stationing on reusable manned space vehicles.

Treaty for the prohibition of nuclear weapons in Latin America (Treaty of Tlatelolco)

Signed at Mexico City on 14 February 1967; entered into force on 22 April 1968

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 IAEA for the application of safeguards to their nuclear activities.

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 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

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.

The 1979 SALT II Treaty extended, for the USA and the USSR, the ban on military activities in the sea-bed environment. It prohibits the development, testing or deployment of fixed ballistic or cruise missile launchers for emplacement on the ocean floor, on the sea-bed, or on the beds of internal waters and inland waters, or in the subsoil thereof, or mobile launchers of such missiles, which move only in contact with the ocean floor, the sea-bed, or the beds of internal waters and inland waters, or missiles for such launchers.

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 (CSCE)

Signed at Helsinki on 1 August 1975

Provides for 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. States may invite observers to attend the manoeuvres.

At the follow-up meeting of the CSCE in 1980–81, proposals were made for mandatory notification of military manoeuvres and movements with fewer than 25 000 men, for setting an earlier date for notification, and for providing observers with substantive information.

Since 1973, talks on the reduction of forces and armaments in Central Europe have been held in Vienna.

VI. Prevention of war

Memorandum of Understanding between the USA and the USSR regarding the establishment of a direct communications link ('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, 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.

An agreement signed on 30 September 1971 improved the reliability of the US–Soviet Hot Line by providing for the establishment of two satellite communications circuits between the USA and the USSR, with a system of multiple terminals in each country.

Direct communications links have also been established between France and the USSR, as well as between the UK and the USSR, following the agreements concluded in 1966 and 1967, respectively.

Agreement between the USA and the USSR on measures to reduce the risk of outbreak of nuclear war ('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.

The 1979 SALT II Treaty extended the obligations of the parties with regard to advance notification of missile launches. All planned multiple launches (that is, those which would result in two or more ICBMs being in flight at the same time), even if the planned trajectories were to be entirely within a party's national territory, would have to be notified.

The French–Soviet and British–Soviet Nuclear Accidents Agreements, concluded in 1976 and 1977, respectively, are patterned after the US–Soviet Agreement.

Agreement between the USA and the USSR 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.

In a *Protocol* signed in 1973, the parties undertook that their ships and aircraft should 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.

Agreement between the USA and the USSR 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.

VII. The humanitarian laws of war

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

Declares that the parties agree to be bound as between themselves by the above prohibition, which should be universally accepted as part of international law, binding alike the conscience and the practice of nations.

Convention on the prevention and punishment of the crime of genocide (Genocide Convention)

Adopted at Paris by the UN General Assembly on 9 December 1948; entered into force on 12 January 1951

Declares genocide, defined as the commission of acts intended to destroy, in whole or in part, a national, ethnic, racial or religious group, as such, to be a punishable crime.

Conventions for the protection of war victims (Geneva Conventions)

Signed at Geneva on 12 August 1949; entered into force on 21 October 1950

Convention I provides for the amelioration of the condition of the wounded and sick in armed forces in the field.
Convention II provides for the amelioration of the condition of the wounded, sick and shipwrecked members of armed forces at sea.
Convention III relates to the treatment of prisoners of war.
Convention IV relates to the protection of civilian persons in time of war.

Protocol (I) Additional to the 1949 Geneva Conventions

Signed at Bern on 12 December 1977; entered into force on 7 December 1978

Relates to the protection of victims of international armed conflicts.

Reiterates the rule of international law 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 use weapons and methods of war that cause superfluous injury or unnecessary suffering. Expands the existing prohibition against indiscriminate attacks to cover attacks by bombardment of cities or other areas containing a similar concentration of civilians or civilian objects. Dams, dykes and nuclear electric power generating stations are placed under special protection. There is also a prohibition to attack, by any means, localities declared as non-defended, or to extend military operations to zones on which the parties conferred by agreement the status of demilitarized zone. Reprisals against the civilian population are forbidden. Guerrilla fighters are accorded the right to prisoner-of-war status if they belong to organized units subject to an internal disciplinary system and under a command responsible to the party concerned.

Protocol (II) Additional to the 1949 Geneva Conventions

Signed at Bern on 12 December 1977; entered into force on 7 December 1978

Relates to the protection of victims of non-international conflicts.

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.

Convention on the prohibitions or restrictions on the use of certain conventional weapons which may be deemed to be excessively injurious or to have indiscriminate effects

Signed at New York on 10 April 1981; not in force by 31 December 1981

The Convention is an 'umbrella treaty', under which specific agreements can be concluded in the form of protocols.

Protocol I prohibits the use of weapons intended to injure by fragments which are not detectable in the human body by X-rays.

Protocol II prohibits or restricts the use of mines, booby-traps and similar devices.

Protocol III prohibits or restricts the use of incendiary weapons.

18. Chronology of major events related to arms control issues

January–December 1981

9–13 February At a meeting held in New Delhi, the foreign ministers of the non-aligned countries urge the great powers to begin reducing their military presence in the Indian Ocean area. They also condemn all forms of intervention in the internal affairs of El Salvador.

23 February Speaking at the Soviet Communist Party Congress about confidence-building measures in Europe, President Brezhnev says that the Soviet Union is prepared to give notification of naval and air force exercises. He also proposes advance notification of large-scale troop movements. The USSR is ready to apply these measures to the entire European part of the USSR, provided the Western states, too, extend the confidence zone correspondingly. Furthermore, the Soviet Union is willing to come to terms on limiting the deployment of US Ohio-type submarines and of similar Soviet submarines; it could also agree to the banning of the modernization of existing, and the development of new, ballistic missiles for these submarines. Regarding nuclear missiles in Europe, the Soviet Union proposes a moratorium on the deployment of new medium-range nuclear-missile systems by NATO countries as well as by the Soviet Union, that is, a quantitative and qualitative freeze on the existing levels of these weapons, including US forward-based nuclear systems in this region.

7–8 April In a communiqué of the NATO Nuclear Planning Group meeting in Bonn, the participating ministers emphasize that NATO will move ahead with its schedule of long-range theatre nuclear forces modernization, while at the same time making efforts to reach balanced, equitable and verifiable arms control agreements limiting such forces, as was decided in December 1979. They consider that the Soviet proposal for a moratorium on long-range theatre nuclear forces deployment would not address the fundamental problems caused by the momentous build-up of Soviet arms.

10 April The Convention on the prohibitions or restrictions on the use of certain conventional weapons which may be deemed to be excessively injurious or to have indiscriminate effects opens for signature in New York.

29 April The South African Minister for Mineral and Energy Affairs announces that South Africa is now producing 45 per cent-enriched uranium.

5 May In a speech made in Chicago, the US Secretary of Defense says that the United States cannot and should not rely exclusively on strategic forces and will need a strong conventional capacity.

5 May In a communiqué of the North Atlantic Council meeting in Rome, the participating ministers reaffirm their support for the French proposal for a conference on disarmament in Europe, aimed at achieving, in an initial phase, an agreement on a coherent set of militarily significant, binding and verifiable confidence-building measures, applicable to the whole European continent, from the Atlantic to the Urals. They consider that the Soviet proposal for a moratorium on long-range theatre nuclear forces deployment would freeze NATO inferiority by blocking the modernization programme.

13 May In a communiqué of the NATO Defence Planning Committee meeting in Brussels, the participating ministers state that NATO would continue to seek to negotiate equitable, militarily significant, binding and fully verifiable arms control agreements in order to achieve a balance of forces at lower levels. The allies recognize that arms control negotiations can lead to fruitful results only in an international climate of confidence.

7 June The Israeli Air Force attacks nuclear installations in Iraq.

26 June In an interview published in the Finnish newspaper *Suomen Sosialdemokraatti*, President Brezhnev supports the idea of establishing a nuclear weapon-free zone in northern Europe. He says that the Soviet Union is ready to consider in this connection certain measures applicable to the territory of the USSR in the region adjacent to the nuclear-free zone in the north of Europe.

8 July The US President signs a directive on conventional arms transfer policy. The directive says that the United States views the transfer of conventional arms and other defence articles and services as an essential element of its global defence posture and an indispensable component of its foreign policy.

16 July The US President makes a statement outlining his policy on limiting the spread of nuclear weapons. The United States will view a material violation of the Non-Proliferation Treaty, the Treaty of

Tlatelolco, or an international safeguards agreement as having profound consequences for international order and US bilateral relations, and would also view any nuclear explosion by a non-nuclear weapon state with great concern. The United States will continue to work with other nations to strengthen the IAEA to provide for an improved international safeguards regime, and will continue to inhibit the transfer of sensitive nuclear material, equipment and technology, and to seek agreement on requiring IAEA safeguards on all nuclear activities in non-nuclear weapon states as a condition for any significant new nuclear supply commitment.

6 August The US President decides that the United States should proceed with the full production of neutron weapons. The weapons are to be stockpiled in the USA and any future deployment in Europe would be carried out only after consultation with the allies.

10 August The Soviet Union proposes the conclusion of a treaty on the prohibition of the stationing of weapons of any kind in outer space, and suggests that the question should be discussed at the UN General Assembly.

23 September A spokesman for the US Defense Department states that the United States might open the way within six months for the resumption of SALT negotiations with the Soviet Union.

26 September The General Conference of the International Atomic Energy Agency adopts a resolution stating that the Israeli attack on Iraqi nuclear installations on 7 June 1981 constitutes an attack against the Agency and its safeguards regime, which is the foundation of the Non-Proliferation Treaty. The Conference decides to suspend immediately the provision of any assistance to Israel under the Agency's technical assistance programme.

8 October The US President announces the immediate lifting of the 1977 ban on the reprocessing of spent fuel from nuclear utilities. US government agencies are ordered to proceed with the Clinch River breeder reactor. A study is to be made of the feasibility of obtaining plutonium through competitive procurement instead of relying solely on government-owned facilities.

10 October According to press reports some 250 000 to 300 000 people meet in Bonn to protest against the new nuclear armament programmes in the East and West, and particularly against the Euro-strategic missiles.

16 October At a meeting with newspaper editors, President Reagan says that he can see where "you could have the exchange of tactical weapons against troops in the field without it bringing either one of the major powers to pushing the button".

21 October The US Senate decides that foreign aid should be suspended in the case of a country not possessing nuclear weapons that explodes a nuclear device.

21 October In a communiqué of the NATO Nuclear Planning Group meeting in Gleneagles, Scotland, the participating ministers express their support for the US commitment to arms control efforts to achieve substantial, balanced and verifiable reductions in strategic weapons. They agree that the claims by the Soviet Union that there is currently parity in long-range theatre nuclear forces have no basis in fact.

27 October The follow-up Conference on Security and Co-operation in Europe resumes its deliberations in Madrid after a three-month interval.

3 November In an interview with the West German journal *Der Spiegel*, President Brezhnev says that there is now an approximate equality in the medium-range delivery vehicles between NATO and the USSR in Europe: that is, between nuclear missiles and air forces of NATO countries, which can reach targets on the territory of the Soviet Union from the territories of the West European countries and the waters adjacent to Europe (that is, with a range of 1 000 kilometres and more, but less than the intercontinental range) on the one side, and the corresponding Soviet armaments of analogous range, deployed in the European part of the USSR, on the other side. NATO countries possess 986 such vehicles, while the Soviet Union possesses 975.

4 November Testifying before the US Senate Foreign Relations Committee, the US Secretary of State says that contingency plans in the event of a conventional war in Europe include the exploding of a nuclear warhead as a "demonstration" to deter the Soviet Union from trying to overrun Western Europe.

9 November The Spanish Defence Minister declares in a television interview that Spain has the technical knowledge and the industrial facilities to manufacture nuclear weapons.

18 November Addressing the National Press Club in Washington, President Reagan makes the following proposals. The United States is prepared to cancel its deployment of Pershing II and ground-launched cruise missiles if the Soviet Union would dismantle its SS-20, SS-4 and SS-5 missiles. It proposes to open negotiations on strategic arms as soon as possible next year, and seeks to negotiate substantial reductions in nuclear arms, which would result in levels that are equal and verifiable. It further proposes to achieve equality with the Soviet Union at lower levels of conventional forces in Europe, and suggests a conference in Europe to develop effective measures that would reduce the risks of surprise attack and the chance of war arising out of uncertainty or miscalculation.

20 November The UN group of experts appointed by the Secretary-General to investigate reports on the alleged use of chemical weapons (mainly in south-east Asia) submits an inconclusive report. The experts say that timely access to the areas of alleged use of chemical warfare agents would be required to establish the facts.

21 November According to press reports, some 400 000 people demonstrate in Amsterdam against nuclear weapons in Europe.

23 November President Brezhnev rejects President Reagan's offer made on 18 November concerning land-based, medium-range nuclear weapons in Europe. Renewing his offer for a US–Soviet moratorium on the deployment of new medium-range nuclear weapons in Europe, President Brezhnev says that the USSR is prepared to reduce unilaterally a certain portion of its medium-range nuclear weapons in the European part of the Soviet Union.

23 November The USA ratifies Additional Protocol I of the Treaty of Tlatelolco, submitting US territories in Latin America to the denuclearized regime.

30 November The USA and the USSR start meeting in Geneva to conduct "intermediate nuclear force negotiations", as they are called by the USA, or "talks on the reduction of nuclear arms in Europe", as they are called by the USSR.

2 December In a communiqué of the foreign ministers committee of the Warsaw Treaty Organization meeting in Bucharest, the participants deplore the NATO decision to deploy new US medium-range nuclear missiles in Europe and the US decision on the production of neutron weapons. They advocate military parity at a lower level, and express themselves in favour of a Europe eventually free of nuclear weapons—both medium-range and tactical.

9 December The French Defence Minister, speaking in the French National Assembly, states that on 11–12 March 1981 a storm dispersed radioactive products from pre-1975 testing contained under an asphalt surfacing.

9 December The UN General Assembly declares that the use of nuclear weapons would be a crime against humanity. The Assembly asks all states to refrain from any action which could impede negotiations on a convention prohibiting chemical weapons, and specifically to refrain from the production and deployment of binary and other new types of chemical weapons. The Assembly extends the mandate of the group of experts investigating reports on the alleged use of chemical weapons. The Committee on Disarmament is requested to work out agreements to prevent the spread of the arms race to the outer space, in particular an agreement banning anti-satellite systems.

11 December In a declaration of the North Atlantic Council meeting in Brussels, the participating ministers express their full support for the US approach to the negotiations on intermediate-range nuclear forces. They point out that the Soviet Union now possesses some 1 100 warheads on long-range intermediate nuclear force missiles.

Errata

World Armaments and Disarmament, SIPRI Yearbook 1981

Three figures for Taiwan were incorrectly given in the last Yearbook. These affect various sub-totals and totals, as follows:

Page 163, table 6A.3

	1978	1979	1980
Taiwan	[70.2]	80.7	96.5

Page 167, table 6A.4

	1978
Taiwan	[8.5]

Page 159, table 6A.2

	1978	1979	1980
Taiwan	[1 896]	2 000	2 274
Total Far East, excl. Kampuchea, Laos and Viet Nam	19 850	(20 625)	(21 080)
Total Far East	[21 173]	[22 000]	[22 485]

Page 156, table 6A.1

	1978	1979	1980
Far East	[21 173]	[22 000]	[22 485]
World total	434 513	442 538	452 030
Non-oil developing countries: with (1977) GNP *per capita* > US $800	15 191	16 750	19 582
Total non-oil developing countries	29 738	31 642	35 305

Page 167, table 6A.4

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Syria	9.1	8.9	15.8	11.3	17.1	15.8	16.1	14.9	23.7

Page 168 — Read "Nigeria" for "Niger".

Page 169, Notes — The last two lines of footnote [a] were omitted. These should read:

> "*Non-oil developing countries* include the rest of the world, excluding Kampuchea, Laos and Viet Nam.
> *Southern Africa* includes Mozambique, Tanzania, South Africa, Zambia and Zimbabwe."

ıge 171, line 4 — Line should read: "other than the Soviet Union include for Czechoslovakia, the German Democratic Republic and Poland some".

age 171, lines 12–15 — Delete last sentence of the paragraph, from "In the cases . . . [to] . . . to the tables."

Page 431 — The footnote by "United States, ENMOD Convention" should be deleted. The date "17 Jan 1980" should be inserted.

INDEX

WORLD ARMAMENTS AND DISARMAMENT

SIPRI *yearbook* *1982*

This is the thirteenth SIPRI Yearbook. The aim of the Yearbooks is to bring together information on world armaments and the efforts made to limit or reduce them. The first twelve Yearbooks attracted world-wide attention and were used extensively in the United Nations, in international disarmament negotiations and in national parliamentary and government debates as an authoritative source of information.

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