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A NEW APPROACH TO COMPREHENSIVE DISARMAMENT

The time has come to have a new look at the efforts to achieve arms control and disarmament and to stop and reverse the accelerating arms race and the ever-rising spiral of military expenditure.

Despite the achievement of more than a dozen arms control agreements during the past decade, the conclusion of the Berlin and German agreements, the withdrawal of American troops from Vietnam, the thawing of the cold war and the beginnings of detente between the United States and the Soviet Union, and the diminishing danger of a major war, the disarmers appear to be losing the race to control the arms race.

The "incremental" or step-by-step approach which led to the conclusion of seven multilateral and eight bilateral (US/USSR) arms control agreements seems to have exhausted itself. The negotiations appear to have lost their momentum and to be reaching a stalemate. The small additional steps that are now being negotiated raise doubts as to whether they are more for "cosmetic" purposes than for real arms control or disarmament. The agreements concluded have failed to slow down the arms race and have in fact helped to speed up its technological and qualitative aspects. Progress in military technology has far out-run progress in arms control.

If all of the negotiations now proceeding at SALT II, at the Conference of the Committee on Disarmament, at the Force Reduction Talks in Vienna and at the Conference on European Security and Co-operation, were to succeed in their stated objectives (an eventuality much to be desired), the technological arms race and the massive military expenditures would continue to escalate. The arms control agreements already signed and those now being negotiated seem to be designed not to halt or reverse the arms race but rather to institutionalize it and to allow it to continue under conditions of less instability or insecurity.

Three years ago the United States declared the decade of the 1970's as the Disarmament Decade and asked the C. C. D. to work out a comprehensive programme of disarmament to provide a guideline for future work. Unfortunately, no serious thought was given to working out either a comprehensive programme or even a new statement

of principles and goals.

If progress is to be made towards genuine and substantial arms control and disarmament and the reduction of the crushing burden of military expenditures, some new thinking and some new approaches are necessary. Perhaps a possible way out of the difficulty would be to raise our sights and aim at a more comprehensive general plan with clear objectives and within a fixed but flexible target period rather than continue in the present haphazard way towards limited piecemeal objectives.

Practically every measure of arms control and disarmament -- whether nuclear or conventional and whether it concerns armies, navies or air forces -- is interlinked with every other measure from both the national and international points of view. Each step affects the broad picture of national and international security and is also inter-linked in this inter-dependent world with problems of development and economic security. Hence larger package agreements should be easier to achieve, because it would be easier to attain a broad balance of measures than would concentrating on narrow unconnected measures. Moreover, the problem of verification would become simpler because of the reinforcing effect of controls for several measures.

An integrated comprehensive plan for real arms control and disarmament would attract public interest and provide the necessary incentive for top political leaders, high governmental officials and scholars to give priority to the achievement of the goals and to overcome the inertia that helps keep the arms race going.

#### A Comprehensive Plan for Arms Control and Disarmament for the Next Decade.

This paper attempts, in the light of the great political and strategic changes in the world in the last two years, to outline a comprehensive programme for disarmament for the next decade designed to achieve major reductions in all arms, armed forces and military expenditures. Such a programme can be envisaged in three stages. A model programme, listing possible measures for negotiation in each stage, is set out in the Annex hereto.

I. The First Stage would be devoted to halting the present arms race. It would no doubt be necessary to continue the present efforts to achieve the limited agreements now being negotiated in the existing forums. An essential difference, however is that the various items now being negotiated would be regarded as integrated elements at the beginning of an over-all plan and as

preliminaries to the later and more important stages. A primary objective in this stage would be to agree on measures that would prevent both the vertical and the horizontal proliferation of nuclear weapons as interrelated goals; it would also envisage some first steps towards grappling with the problems of conventional arms and military expenditures.

II. The Second Stage would be regarded as the period for reversing the arms race, i.e. for the beginning of real disarmament.

A primary objective for this stage, indeed its starting point, would be the holding of a World Disarmament Conference by 1976 or 1977. In this connection reference should be made to the companion paper on a World Disarmament Conference.

The successful conclusion of a number of arms limitation agreements during the First Stage would prepare the ground both substantively and procedurally for convening the W.D.C. By that time it is also possible that China and the United States would have changed their present positions and would have a positive and co-operative attitude towards such a conference. The W.D.C. could mobilize and give expression to the aspirations of humanity, and provide new impetus and modalities for achieving them on a global public scale. It would bring together all of the negotiations now proceeding in various bodies, and provide a new forum where both China and France could participate fully. It could also give a new overview, and new directions to the entire range of problems in the field of arms control and disarmament.

This stage would be the period for concrete and substantial reduction of nuclear arms, armed forces and conventional armaments and of military expenditures.

The Second Stage might last for 3 to 5 years.

III. The Third Stage would be the period for far-reaching disarmament, the elimination of some categories of weapons and embarking on a new approach to both arming and disarming. It would also be the stage for establishing greater international confidence and a more stable system of international security. As armaments were progressively reduced and greater openness and mutual trust were created, the peace making and peacekeeping machinery of the United Nations could be further developed and strengthened, and a sharp increase in aid to the developing countries would help ensure a more equitable distribution of wealth between the rich and the poor nations. This period could also last for 3 to 5 years with a view to its being substantially achieved by the middle of the 1980's.

#### Institutional and Methodological Arrangements

In order to facilitate the carrying out of the above comprehensive programme for arms control and disarmament, and as an intrinsic part of the programme, a number of new approaches and new inputs would be necessary in order to create greater public and governmental support.

##### 1. The Educational Effort

Beginning with the First Stage, a massive effort should be undertaken to educate legislators, students and the public generally by means of more study, publicity and information. Efforts should be made in all the major countries to establish agencies similar to the U.S. Arms Control and Disarmament Agency to work on the problem in an organized and permanent way and, in the U.S.,

pressure should be exerted to increase the budget, staff and effectiveness of A.C.D.A.

The useful work done by the Pugwash Movement should be intensified and expanded, with a larger permanent staff and the convening of more frequent conferences of both governmental and non-governmental scientists and experts.

Peace research institutes should also intensify their work and a number of institutes similar to SIPRI should be established in the main countries of the world, including the Third World, which would operate on a permanent basis with a permanent staff of experts and researchers.

Universities should also conduct full-time courses dealing with the whole range of problems of the arms control and disarmament.

The above steps would in fact implement a resolution adopted by the U.N. General Assembly in 1971 specifically calling for more international conferences of experts and scientists on the problems of the arms race and disarmament, and for universities and academic institutes to establish continuing courses and seminars.

## 2. Greater use of the U.N. Security Council

It should become regular practice for any country which wished to increase its military expenditure or any of its armed forces or armaments, because of the perception of threat from some other countries or for any reason whatsoever, to come to the Security Council to explain the threat and to "justify" the need to increase its military strength. This would enable the U.N. to exercise some preventive diplomacy and head off both a potential local arms race and the development of an acute political crisis.

3. The publication by the U.N. of an Official Armaments Year Book to cover armed forces, nuclear and conventional armaments and military expenditures.

4. The creation by the U.N. of an "Arms Review Committee" which would examine the annual military budgets and policies of all countries, both nuclear and non-nuclear, with a view to having each country explain why it needed a budget of the reported size. At first the review would be confined to the major military powers.

5. The international exchange of scientific and technical information that might have important military applications.

This idea was originally put forward by Dag Hammarskjold in 1958 as a means of removing fear and suspicion and helping to build mutual trust and confidence. A similar idea was also supported by the late Academician L. A. Artsimovitch at the 1967 Pugwash Conference at Ronneby.

6. The internationalization of information obtained by national means of verification.

The results of the remarkable progress in satellite surveillance and telecommunication monitoring should be made internationally available. The great powers, who have national means of obtaining information concerning the status and deployment of armaments, should make this information available to an appropriate organ of the United Nations as a means of maintaining some continuous monitoring of the arms race, as a means of verification of arms control and disarmament agreements, and as an additional way to build greater confidence and trust.

The ideas set out above, and the outline of a comprehensive programme for arms control and disarmament for the next decade contained in the Annex hereto, are not intended as a rigid programme with a hard and fast schedule, but merely as a model of what should be aimed at. The various measures listed could be accelerated, postponed, or modified depending upon how the negotiations developed. But a well-formulated, integrated, comprehensive list of measures would hold out better prospects for its acceptability and greater hopes for its achievement. Such a programme could also help to establish the legitimacy of arms control in place of the legitimacy of the arms race.

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## ANNEX

### A Model Programme for Comprehensive Arms Control and Disarmament for the Next Decade

#### I. First Stage (2 - 3 years)

1. A comprehensive test ban, i.e. a ban on underground nuclear tests, by the U.S. and U.S.S.R. In addition, the suspension of underground tests for peaceful purposes pending agreement on an international regime for peaceful nuclear explosions.
2. A cut back in nuclear bombers and land-based ICBM missiles.
3. A limitation on flight testing of missiles.
4. Cessation of production of fissile material for military purposes and the transfer of stocks for use in power reactors.
5. Agreement for a nuclear free zone for Africa or, if the Middle East situation is stabilized, for all of Africa and the Middle East.
6. A declaration or agreement for the non-use of nuclear weapons against non-nuclear States that do not have nuclear weapons on their territories.
7. Agreements concerning security and disengagement in Europe.
8. Agreement on a comprehensive (or partial) elimination of chemical weapons.
9. Some limitation on the conventional arms race involving Asia, Africa, and Latin America, beginning with the Middle East.
10. A freeze on all military expenditures at 1974 levels.
11. More information, study and publicity for arms control and disarmament.

#### II. Second Stage (3 - 5 years)

1. Convening of a World Disarmament Conference.
2. A declaration by all nuclear powers of the non-first-use of nuclear weapons.
3. Destruction by the USSR and US of additional categories of nuclear bombers and ICBMs.
4. A ban on the further production of all nuclear weapons and delivery systems.



5. The ending of all Chinese and French tests of nuclear weapons.
6. Agreement on limiting the areas for deployment of strategic and tactical nuclear weapons, bombers and submarines.
7. Agreement by the nuclear powers to limit the further development and deployment of anti-submarine warfare (A S W) systems.
8. A ban on testing and deployment of new mass destruction and unconventional weapons of warfare such as meteorological warfare, laser weapons etc.
9. Establishment of additional nuclear free zones in other areas of the world.
10. A reduction of military expenditures, either by agreement or unilaterally by "mutual example", with a substantial portion (25%) of the savings allocated for aid to developing countries.
11. Agreements for the reduction of armed forces and conventional armaments on a bilateral, regional, and global basis.
12. Establishment within the UN of the procedures and machinery described in the paper under the heading, "Institutional and Methodological Arrangements".

### III. Third Stage (3 - 4 years)

1. Elimination of all land-based and bomber carried strategic nuclear systems.
2. Fixing numerical ceilings for submarine-launched nuclear missiles at a figure of from 100 to 200.
3. The elimination of all tactical nuclear weapons.
4. The elimination or drastic reduction of all foreign military bases.
5. The progressive and substantial reduction to agreed levels of all armed forces and conventional armaments.
6. The progressive and substantial reduction to agreed levels of all military expenditures, with a substantial portion of the savings to be allocated for aid to the developing countries.

A WORLD DISARMAMENT CONFERENCE

The idea of holding a World Disarmament Conference (WDC) in order to promote arms control and disarmament is not new. At the time of the League of Nations, a World Disarmament Conference in 1932 and 1933 had approved a draft Disarmament Treaty in the first reading and was making notable progress but its work was aborted by the rise of Nazism in Germany.

During the years since the founding of the United Nations, many proposals have been put forward for the holding of such a conference. In the 1950's the Soviet Union was the main protagonist. Beginning in 1961 the non-aligned powers became interested and proposed that WDC be held; they have repeated their proposals in 1964, 1972 and 1973. In 1964 at the time of the explosion of its first nuclear bomb, China also proposed a World Disarmament Conference at the summit level but laid down a strict agenda for it -- the complete prohibition and thorough destruction of nuclear weapons, and that, as a first step, the summit conference should reach agreement that the nuclear powers undertake not to use nuclear weapons against non-nuclear countries or against each other.

The United Nations General Assembly itself in 1965 explicitly called for a World Disarmament Conference, but nothing came of the idea because China, which at that time had not yet taken its place in the United Nations, refused to consider it.

The Soviet Union took a major new initiative in 1971 in proposing a WDC. This initiative became the basis of the new efforts to convene a World Disarmament Conference. The General Assembly approved the idea and called on all states to convey to

the Secretary-General their views and suggestions on the conference, including its main objectives, agenda, site, date, preparatory work and relationship to the United Nations. Thereafter the idea became a United Nations objective and agenda item. It was generally understood that there would be little point in holding such a conference unless all of the 5 nuclear powers were present, and that it would have to be most carefully prepared.

China said such a conference would be useless and would only delude the peoples of the world unless all the nuclear powers first agreed to pre-conditions before the conference was held -- namely to undertake not to be the first to use nuclear weapons and to liquidate all their foreign military bases; the conference itself would seek the prohibition and destruction of nuclear weapons and the reduction of conventional weapons. However, faced with the virtually unanimous desire of the Third World and non-nuclear countries for the holding of a WDC, China has joined the other nuclear powers in supporting unanimously adopted UN resolutions in 1972 and 1973 calling for a study of the matter. Most observers think that China is merely trying to delay the holding of such a conference until it has built up its own nuclear arsenal.

The United States also opposed a World Disarmament Conference and was the only country to abstain on the 1971 Assembly resolution. In 1972 it stated in the General Assembly that it was even opposed to and would not participate in any preparations for holding such a conference. It stated that it prefers to work through SALT, the CCD and other small negotiating bodies, and believes that a conference attended by some 140 countries would be counter-productive and could lead to great disappointment among the nations and peoples of the world. Nevertheless, earlier, at the 1972 Summit in Moscow, and at Summits II and III, the United States did agree with the Soviet Union to the holding of

such a conference at the "appropriate time", although it has never explained what it would regard as the appropriate time.

France and the United Kingdom have supported the idea of a world disarmament conference provided that all the nuclear powers participate in it. They, together with the USSR, participate in the meetings of the Ad Hoc Committee on the World Disarmament Conference, consisting of 40 non-nuclear states, created by the General Assembly in December 1973, to examine all governmental views and suggestions on a WDC and the conditions for its realization. China and the United States do not participate in the work of the Ad Hoc Committee but have agreed "to co-operate or maintain contact" with it.

The need for a WDC is becoming more urgent every day. The arms race, both nuclear and conventional, seems to be out of control and despite the developing détente and the diminishing threat of a war between the great powers, military expenditures are escalating and the arms race is accelerating. Military expenditures in the last decade have more than doubled from some 120 to some 240 billion dollars per year. Even in terms of constant prices they have gone up by more than 50%. Despite 7 multilateral and 10 bilateral (US/USSR) arms control agreements during the last decade, and the current negotiations at SALT II, at the Conference of the Committee on Disarmament, at the Force Reduction Talks in Vienna and the Conference on European Security and Co-operation, there seem <sup>to be</sup> no early prospects of a halt to, let alone a reversal of, the arms race.

In fact, the current negotiations seem to have reached a stalemate. The SALT II talks, despite the principles laid down at the Washington Summit in 1973, seem unable to produce any measures for a genuine limitation or reduction of arms. Summit III in Moscow in June produced agreements that were "cosmetic" or worse. Neither quantitative nor qualitative limitations seem likely in the near future. The CCD's efforts to achieve a comprehensive test ban were probably set back by the threshold test ban treaty that is to take effect on 31 March 1976 and permits underground tests up to 150 kilotons; and prospects for the elimination of all chemical weapons have been indefinitely delayed by the American-Soviet agreement to consider a first-step ban on the most lethal CW agents. The Force Reduction talks in Vienna and the CSCE talks, even if they succeed, would at most provide aspirins or tranquilizers when radical surgery is needed. The Non-Proliferation Treaty has been put in jeopardy by the Indian peaceful nuclear test in May, by the dubious threshold test ban treaty in June, and by the continuing vertical proliferation of nuclear weapons by the nuclear powers.

It is clear that a new approach is necessary. Such an approach is set forth in a companion paper, "A New Approach to Comprehensive Disarmament". Such a new approach could be greatly facilitated if a WDC is held.

A WDC would help to stimulate and capture the imagination of world leaders as well as of the peoples of the world. It would focus the yearnings of mankind for disarmament and a better world on a world-wide stage which would attract the interest and attendance of statesmen at the highest level. It would demonstrate that the world-wide problems of arms control and disarmament, which

are interlinked with the world-wide problems of development and international security, were being dealt with on a global scale. It would be able to place the present unco-ordinated and fragmented efforts for disarmament under a single roof. It would be able to provide for a continuing overview of all the negotiations now proceeding in different forums and help to bring better organization and planning to the efforts for disarmament. It could thus provide the drive and impetus to come to real grips with the uncontrolled arms race.

A WDC should not be regarded as a one-time affair but as a continuing body holding plenary deliberative sessions every 2 or 3 years, or sooner if useful, with the detailed negotiations being conducted between plenary sessions by smaller negotiating committees. New committees could replace some of the existing forums and make it possible for countries such as China, France, the two Germanies and other militarily important states to participate actively.

Two years ago the United Nations held a successful Environment Conference in Stockholm which helped to stimulate action. This year it held a Special Session of the General Assembly (somewhat like a World Conference) on the Problems of Raw Materials and Development. It has just held a World Population Conference in Bucharest. It is holding at the present time a Conference on the Law of the Sea at Caracas. It will be holding a World Conference on Food in Rome in November. It is becoming increasingly clear in this inter-dependent world that only global strategies can meet the global problems facing mankind. Disarmament is not the least of these problems. It is time to hold a World Conference also on this problem, which has been described by all the leading statesmen at one time or another as the most important problem in the world.

In any case the idea of a WDC seems to have caught on and the holding of such a conference seems to be only a matter of time. The Ad Hoc Committee on the WDC will be submitting a report to the forthcoming session of the General Assembly. If sufficient pressures are exerted on governments, it is possible that the General Assembly, which will open in a few days, will be able to set up a preparatory committee for the WDC and that a WDC may become a reality in 1976 or 1977.

A World Disarmament Conference can do more than any of the present bilateral, regional, or multilateral conferences to promote the cause of arms control and disarmament. It could provide the necessary momentum to replace the "mad momentum" of the arms race. It could help establish the legitimacy of arms control in place of the existing legitimacy of the arms race.

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DISARMAMENT THROUGH UNILATERAL INITIATIVES

Recent developments in the field of armaments and disarmament are disturbing and should cause concern. The pace of growth of armaments outstrips by far the pace of disarmament negotiations. While arms control and disarmament talks stagnated into protracted diplomacy, armaments revolutionized by modern technology have accelerated to such an extent as to bring into question the very modest results achieved in years of disarmament negotiations. Both the checking of nuclear proliferation and the limitation of strategic armaments are now in danger of being subverted, whereas conventional armaments have come to experience a technological upsurge incomparable to any period in history. Détente has certainly contributed to ameliorating the atmosphere between East and West, but it has not halted the arms race. At the same time, its psychological effect may have acted to attenuate our sense of urgency concerning disarmament.

The arms race invigorated

It is time to pause and reflect. We seem now to have reached another critical turning point in the development and perfection of both nuclear and conventional weapons.<sup>1</sup> Out of the testing grounds in Indochina and the Middle East came a "quiet revolution" in conventional warfare.<sup>2</sup> New generations of war planes, gunships and bombers were developed. Military laser technology with its ominous potential for destruction has seen the light of day. A variety of new air and ground weapons, including "smart" bombs, new types of guided missiles, an assortment of sensors and anti-personnel weapons were put into use. Electronics and computers came to dominate the so-called "automated battlefield".<sup>3</sup> Following closely upon these developments, a multitude of new conventional matériel is now proliferating to all continents, and Europe is no exception.

On the other hand, vertical-qualitative breakthroughs are reported in strategic weaponry. The notorious MIRVs (multiple independently targetable re-entry vehicles) were joined by MARVs (manoeuvrable re-entry vehicles), leading to a much improved accuracy in nuclear missiles.<sup>4</sup> Simultaneously, new kinds of "miniature" nuclear arms, the so-called "mini-nukes" combining lower explosive power with extreme precision of targeting, have reached the production line.<sup>5</sup> All these technological advances seem to have a strong impact on military postures. They tend to revise traditional war concepts



and pose in a new way the problems of war and peace. Improved weaponry generated new scenarios for the conventional battlefield and led the military to devise new "flexible" options for "limited" nuclear warfare.<sup>6</sup> Moreover, military experts were encouraged to speak about elimination of the threshold between nuclear and conventional warfare.

### Technology and politics

It would seem evident that intensified efforts are needed to bring about a reversal of existing trends, and to infuse new dynamics into the disarmament process. As far as the Pugwash movement is concerned, one remark may be relevant: Pugwash has perhaps set too much hope on technological solutions while the core problems seem to be political. Whatever theory one applies for the explanation of actual armament dynamics - the action-reaction model, the autistic or internal paradigm<sup>7</sup> (spelled out by SIPRI as technological, economic and bureaucratic pressures)<sup>8</sup>, or the pure political interpretation pointing on the one hand to the role of imperialism and on the other to communist expansionism - the political element seems predominant. Indeed, political wisdom and will are needed to face and stand against the powerful combined pressures of research and development, the vested industrial interests, the military establishments, and the cold war ideological dogma. Thus, while no efforts should be spared to urge change and to press on with current arms control and disarmament negotiations, new and unorthodox departures must be sought for a fresh take-off in the reduction and limitation of armaments.

### Unilateral reciprocated initiatives

One of the strategies which may have a salutary effect on disarmament is de-escalation based on unilateral initiatives.<sup>9</sup> Started by exemplary unilateral cuts in armaments by one party, the de-escalation process could, through reciprocation, develop into a chain reaction of graduated arms reduction. Initiative and challenge would unite to generate a new environment and new pressures for disarmament. Once initiated, no party could easily drop out of the process, which could thus achieve a snowballing effect. Of importance is the fact that successive unilateral initiatives could be graduated in risk so as not to jeopardize one's own basic security. Indeed, because of the diversity of the strategic scene, its quantitative and qualitative aspects, its dispersion in space and time, and the multiple functional elements in the military build-up, there may be a million opportunities for unilateral initiatives with no threat for real security. One could, e.g., start with purely confidence building measures,<sup>10</sup> with partial freezing of military budgets, with greater openness in military debate,<sup>11</sup> with reduction of some offensive in favour of defensive weapons,<sup>12</sup> or - what might be of overriding weight - with a gradual diminution of military research

and development.<sup>13</sup> From the point of view of immediate application, the talks on mutual force reduction in Europe may well offer good openings for action.

Of course, a primary condition for the success of such a strategy is reciprocation. Each unilateral step by one party would have to be followed by similar actions by the other party. But considering the existing political dynamics and, in effect, the changed atmosphere of détente, one cannot possibly see how such a challenge could be left unanswered. On the other hand, should the strategy work, one might arrive at an incremental cumulative process leading progressively from simple partial moves to wide disarmament measures. Unilaterality combined with gradualism offers good prospects for enhancing confidence, reducing fear and dismantling by degrees the military buildup.

#### Favourable conditions

The idea of gradual unilateral disarmament moves is not new and has been debated in circles concerned with disarmament for quite a long time. However, objective conditions, a perceived asymmetry in the state of armaments in East and West, made its application difficult in the past. Taking into consideration the perceived superiority of the West in resources and technology, protagonists of unilateral disarmament initiatives tended to direct their appeals almost exclusively to the United States. But US strategists and political leaders were not willing to listen.

Yet in recent years the situation has undergone a basic change. The balance of forces has been transformed into a state of parity and symmetry in actual military strength. This then opens new perspectives and new possibilities for reciprocated unilateral disarmament initiatives. The way is now open for both sides to take the initiative. The United States may, as a result of new conditions, be willing to reconsider its resistance to unilateral moves, and the Soviet Union might be willing to come forward with moves liable to trigger a chain reaction of real disarmament. In fact, political considerations and military interests linked to the new strategic constellation between East and West tend to favour a new approach to de-escalation in the arms race.

#### The political advantages

From the point of view of concerned involvement in the peace movement, the strategy of graduated and reciprocated arms reduction initiatives offer some exceptional advantages.

First, this strategy presents a unique opportunity to activate public opinion and solicit its support in favour of arms control and disarmament. It is no secret that after some animation and engagement of a fairly broad section of public opinion in support of disarmament

negotiations in their initial stage, the momentum was later lost. Both the turn to technicalities in the negotiations and the protraction of the process had an impact on the movement. Additionally, détente may have contributed to calming anxieties and reassuring minds. In reality, people are largely confused and feel alienated from the diplomatic process. The grasp of the issues involved has receded. Unilaterality combined with reciprocation would invite greater interest from the public and would offer larger opportunities for action. Clear goals could be set for pressuring issues in scope and time, and concrete roles could be devised for mass movements and for specific professional milieux. Obviously, scientists and scholars standing in the centre of the technological revolution could assume special responsibilities.

Secondly, the strategy of unilateral reciprocated disarmament initiatives tends to alter, by definition, the very environment and climate of mutual interaction by opposing parties. It is a strategy with inherent confidence-building dynamics. One of its most important aspects is that it tends to remove secrecy and to bring the negotiations out into the open. Surely, an atmosphere of openness would favour objectivity and a more constructive approach to disarmament. Both establishments and individual negotiators would have to be more accountable and face up to their responsibilities more candidly. Thus, unilateral initiatives would sustain those forces sincerely striving to reduce tension, and would tend to counter manipulations aiming to use protracted negotiations as a screen for actual armaments.

In summary, unilateral reciprocated disarmament initiatives would respond to the long felt need for making the disarmament process more transparent and understandable to public opinion. Disarmament talks and measures would acquire greater concreteness, and, drawing strength from the climate of détente, would themselves contribute to a better atmosphere of understanding. The process of disarmament could be accelerated and further armaments halted. Unilateral moves may not solve all the problems, but as an alternative and supplement to actual endeavours, they are full of promise. They may be a step in the right direction.

NOTES

1. For this and other problems concerning recent developments, consult World Armaments and Disarmament, SIPRI Yearbook 1974, Stockholm Interantional Peace Research Institute, The MIT Press, 1974
2. Cf. *ibid.*, Chapters 2&3
3. cf. *ibid.*, Chapter 11
4. Cf. *ibid.*, Chapter 5
5. Cf. Jorma K. Miettinen: Recent Developments in Tactical Nuclear Weapons and their Bearing on Nuclear Non-Proliferation, Instant Research on Peace and Violence No. 4/1973
6. Cf. Federation of American Scientists: Counterforce Ten Years Later: Plus Ça Change, Public Interest Report, Vol. 27, No. 2
7. See Dieter Senghaas: Arms Race by Arms Control? Bulletin of Peace Proposals, Vol. 1973, No. 4.
8. See SIPRI Yearbook 1974, *op. cit.*, Chapter 7.
9. Cf. Charles E Osgood: Graduated and Reciprocated Initiatives for MBFR in Europe, Bulletin of Peace Proposals, Vol. 1973 No. 4; also Klaus Jürgen Gantzel: MBFR: Pleading Against False Premises and for the Courage to Limited Risk-Taking in the Western Negotiating Position, *op. cit.*
10. Cf. Proposals for Confidence-Building Measures by the Government of Norway, Bulletin of Peace Proposals, Vol. 1973, No. 4.

(cont.)

11. Cf. Statement by Inga Thorsson at the 635th meeting of the Geneva Conference of the Committee on Disarmament (May 14, 1974) on openness in defense expenditure.
12. Cf. Herbert F. York: Deterrence by Means of Mass Destruction, Bulletin of the Atomic Scientists, March 1974 (excerpts in BPP, Vol. 1974, No. 2)
13. See Milton Leitenberg: The Conversion Potential of Military Research and Development Expenditures, Bulletin of Peace Proposals , Vol. 1974, No. 1.

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XXIV-11

NORTH-SOUTH COOPERATION IN SCIENCE AND TECHNOLOGY : SOME LATIN-AMERICAN  
VIEWPOINTS

Working Group 5 of the Pugwash Baden Conference must examine "Different Approaches to International Cooperation in Science and Technology", mainly by "reviewing the experiences of a variety of international organizations with a view towards distilling those aspects of their experience that have a bearing on the conception and organization of future international ventures in technological cooperation".

International cooperation between the so-called "developed" and "underdeveloped" countries, as distinct from cooperation among developed nations, has certain special characteristics that will have to be taken into account. I would like to call the attention of the Group to some Latin-American circumstances that I feel may have some bearings upon our conclusions.

Research activities can be of three types: the expression of a cultural value; a part of the educational process; or have an operational role in national development. In Latin America the first two types usually go together and are physically located in the universities. While the third type is usually absent, where it does exist to any significant degree it is usually based in specialized institutions, independent of but frequently originating within the universities. International cooperation will be affected by these factors in different ways depending on the individual case.

It will not be discussed here whether developing countries should promote all these types of science and technology activities; it is easy enough to accept that each of them is always justified to some degree: but it would probably require a special working group to try to arrive at a concensus as to what and how much is justified in relation to a certain degree of development and economic potential. Furthermore, any agreement would have to recognize that, given the diversity of situations existing among developing nations, only very general principles could be stated.

In Latin America, there is an increasing awareness at the political level of the importance of science and technology, quite frequently based more on intuition than on sophisticated knowledge of the subject. For example, science and technology are being incorporated into the political language, government research councils are proliferating and governments are holding international meetings on the subject. In contrast, the universities are very rarely

seriously concerned with training and research in matters of science policy and administration. The need for academic activities in this field is quite clear, and the opportunity for international cooperation unique. Here, moreover, the gap between developed and underdeveloped worlds is not so wide.

Another circumstance worth pointing out is that this political interest in science and technology, motivated considerably by the progressive economic importance of knowledge over raw materials, is creating a growing demand for technological capability among developing nations. This not only considerably increases the strain on the very limited funds available for international cooperation in science and technology, but also creates new problems and renews some old ones.

The emphasis in international cooperation up to now has been on the cultural and educational role of research. This is easily justifiable on the basis that an adequate infrastructure is an indispensable prerequisite for the development of operational research. Nevertheless, it should be recognized that this emphasis might, in developing nations, help to isolate the scientific and technological system from the development process. Such isolation is an increasingly recognized reality in almost all of Latin America and some governments are developing and implementing a science policy that will allow them to incorporate their system of science and technology into the process whereby they select and adapt imported foreign technology. Furthermore it is believed that in such an action lies the possibility of becoming less dependent and of narrowing the development gap. Acknowledging that the main responsibility for correcting such a situation lies in the developing countries still does not excuse international cooperation efforts from recognizing this fact and trying to help correct it.

Shifting the emphasis or widening the scope of international cooperation from science to technology implies an increased danger of improper international influence on the affairs of the developing nations. It also leads into an area of increased economic and political inter-relationships. It is not unlikely that initiatives towards cooperation in this field, from whatever source, will be increasingly examined for and accused of having effects which are detrimental to all parties involved. Such difficulties cannot excuse international cooperation from entering more actively into this field. International boards participating in the decision process can help in avoiding some of the problems. International organizations are another alternative to be considered, provided one weighs the pros and cons of a regional versus a world scope in their membership and organization.

This increasing concern about the importance of technology in development is also helping to increase the demand for international cooperative efforts in science and technology to locate their activities in the developing nations, so as to create and strengthen regional centres for training and research, especially in problems of local importance. Such a trend should help the development of cooperation among developed nations as well as increasing the

efficiency of the efforts made by developed countries to help in their progress.

Whether such centres should be national bodies with international responsibilities or truly international organizations is also a matter of debate. Although international centres may play a very important role when pooling of resources becomes indispensable or when a new activity is initiated, such institutions probably should not be planned with international cooperation as their main permanent support, unless they are part of a wider and very strong political arrangement among a group of governments. The Latin American experience, at least, seems to support this point of view.

Finally, I would like to point out that as interest and investment in science and, particularly, in technology, increases in Latin America, there arises the risk of diminished participation of the Latin American scientific and technological community in the international cooperation effort. The reasons for this include not only the increased interest of political leaders in these matters, but also the existence of structural problems within governments. In Latin America, basic science is generally part of the university domain, and usually depends on the Ministry of Education for public funds, whose concerns clearly lie in other areas. Technological institutions are generally dependent on the Ministry responsible for their particular type of activity (agriculture, industry, etc.) which is a sound arrangement but, unfortunately, one which limits their development<sup>and importance.</sup> International cooperation in science and technology tends, by definition to be the responsibility of the Foreign Ministry. The role of this latter sector of government is at present going through a serious crisis, due to the increasing technical component of political decisions and the growing international interdependence of the other sectors of government in a world where communications have undergone revolutionary improvements. Not only are political leaders meeting personally to solve international crises, but also each sector of government must deal on a daily basis with international factors when handling their main technical responsibilities, and national coordination must certainly include international matters among their considerations. Therefore, conflicts develop in the delimitation of areas of responsibility between Foreign Relations and other Ministries, and the inappropriate participation of scientists and technologists often results, since science and technology are not well defined components of most governmental structures. Not infrequently, the absence of participants with adequate technical knowledge at international meetings results in the loss of opportunities for developing significant new international collaborations and the diminished efficiency of existing ventures.

This is a complex and sensitive issue that probably merits in itself an imaginative academic analysis, but with regard to international cooperation, it again suggests the need to strengthen training programs and to increase non-governmental activities pertaining to science policy, as well



as underlining the importance of stimulating, and providing opportunities for, discussion by the scientific community of international cooperation in science and technology, and the presentation of their views to Governments and the public at large.

THE INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

I. HISTORICAL BACKGROUND

The idea of creating an international centre for physics under the auspices of the United Nations, with the aim of having a place where physicists from East and West, as well as developing countries, might collaborate in scientific research, was first discussed in September 1960 at the High-Energy Physics Conference in Rochester. During the discussions it appeared clear that, for practical purposes, it would be easier to start with an experiment on theoretical physics only, which could serve as a pilot plant for wider and more ambitious enterprises.

In the same month of September 1960, the Pakistan delegation put forward to the Fourth General Conference of the IAEA a formal resolution for the creation of an international centre for theoretical physics. This resolution was co-sponsored by the representatives of Afghanistan, the Federal Republic of Germany, Iran, Iraq, Japan, the Philippines, Portugal, Thailand and Turkey.

The list of sponsors indicated immediately that the setting up of such a centre was of interest not only to some of the advanced countries but also to the less privileged ones, and in fact the idea immediately met with the enthusiastic support of most developing countries of the world scientific community, and especially of the IAEA directorate. The late Niels Bohr expressed his whole-hearted support for it.

In 1963 the Director General of the IAEA convened a panel of three experts to try to formulate a concrete project for the envisaged institution. The members of the panel were Professors R.E. Marshak (USA), J. Tiomno (Brazil) and L. Van Hove (CERN). In the letter transmitting the report the three physicists stated: "In the course of our discussions we have come to see such great potentialities in the project of establishing

an international centre for theoretical physics that we feel this enterprise to deserve the greatest and most enthusiastic support. We therefore devoted very great attention to many aspects of the problem, especially all questions of principle, and we are glad to report that we have reached unanimous agreement on all the views and recommendations presented in the accompanying paper."

In the report itself the purposes of the Centre to be created are established as:

- (a) The Centre would help and encourage able theoretical physicists from newly developing countries to continue and expand their research work.
- (b) The Centre would serve as a pilot plant for future international research institutes.
- (c) The Centre would promote the cross-fertilization of the various fields of activity within its scope.
- (d) The Centre would make an important contribution to the furtherance of international contacts.

These purposes are then explained and commented on in a report in which the size and the programme of the Centre are formulated in detail for the period of five years.

These documents constituted the basis for the discussions and decisions taken at the IAEA during 1963, which led in June 1963 to the acceptance of the Italian offer and to the creation of the Centre in Trieste in October 1964.

It was decided that the Centre was to function from 1964 to 1968 on an experimental basis. Its creation was based on an agreement between the Agency and the Italian Government.

In 1967, at the end of the first four-year period of experiment, the Agency decided to continue the Centre up to 1974 and to increase its financial contribution towards its running costs and a new agreement was signed with the Italian Government.

During the years 1967-1968 the Directors General of IAEA and UNESCO reached an agreement ratified by the two Agencies in 1969 for the co-

sponsorship of the Centre. As a result of this agreement, since 1970 IAEA and UNESCO have been equal partners in sponsoring the Centre.

## II. OBJECTIVES

By a resolution of the Board of Governors of the Agency the aims of the Centre were defined to be the following:

- (a) to train young physicists from developing countries for research;
- (b) to help in fostering the growth of advanced studies of theoretical physics, especially in developing countries;
- (c) to conduct original research; and
- (d) To provide an international forum for personal contacts between theoretical physicists from countries at all stages of development.

The basic philosophy of the Centre is that whereas there are scores of institutions in the world training young men from developing countries for Ph.D. degrees, there is none which looks after them after they have started on research.

Of these aims the last two were conceived in order to bring the Centre to the highest possible scientific standard, and in this respect the amount of success already achieved in the first period of its existence is best expressed by the words of the late Professor J.R. Oppenheimer: "In less than a year it has become one of the leading institutions in an important, difficult and fundamental field." Professor Oppenheimer was a member of the Scientific Council set up by the Director General of the IAEA to advise him on the work done by the Centre and on its future programmes. Other members of the Scientific Council have been or are: A. Bohr, B.B. Kadomtsev, A. Kastler, D.S. Kothari, V. Latorre, R.E. Marshak, A. Matveyev, R.Z. Sagdeev, V. Soloviev, M. Sandoval Vallarta, L. Van Hove, W. Weisskopf, H. Yukawa and J. Ziman.

The fields of research covered by the Centre have so far been: elementary particles, high-energy physics, field theory, nuclear physics, solid state physics, plasma physics, astrophysics, general relativity and applied mathematics. The Centre was especially successful in bringing together the leading experts from the USA and USSR in particular fields:

for example, plasma physics in 1964, 1965, 1966, 1970 and 1973; elementary particles in 1965; solid state physics in 1967 and 1970 and nuclear physics in 1966 and 1969, to join their efforts for the solution of the most challenging problems of the physical sciences. In this respect, the role of the International Centre has been unique. The Centre also organized symposia, the highlight of which was that on the whole spectrum of contemporary physics in June 1968 attended by 278 participants, eight of whom were Nobel Prize winners.

Excellence in research was a necessary condition for the Centre to meet the first two aims which were fixed with the view of helping the growth of the physical sciences in developing countries.

Before describing the various methods which the Centre called into action to meet these aims, it is useful to remember that the main problems which a university teacher and research worker in a developing country is faced with are:

- (a) isolation; lack of scientific and professional contacts;
- (b) difficulty in gathering scientific information and equipment;
- (c) poor social and economic considerations; and
- (d) heavy teaching loads which leave no time for research.

As a result of these difficulties, the best scientists in a developing country are faced with the dilemma either to accept a position in an advanced country, with the consequence of being lost to their home countries, or to continue to contribute to the building up of a local scientific community at home, with the consequence of being lost to science as well as giving up any legitimate aspiration to personal success as scientists. In many cases, young and brilliant scientists from developing countries choose the first alternative, which results in an incalculable loss to their home countries.

### III. SCHEMES FOR HELPING PHYSICISTS FROM DEVELOPING COUNTRIES

The schemes which the Centre set up for helping the physicists in developing countries and encouraging them to continue to work there are the following:

- (a) Extended high-level seminars;
- (b) The Fellowship Programme;
- (c) The Associateship Scheme;

(d) Federation Agreement Scheme.

These schemes are developed with a view to satisfying the specific needs of university teachers in developing countries and are illustrated below in some detail:

(a) Extended Seminars

The extended seminars lasting for up to three months are organized in specialized topics, mostly in the field of nuclear and condensed matter physics and more recently in atomic physics and applicable mathematics. It must be recognized that teachers of physics in developing countries cannot obtain a long leave of absence on account of scarcity of staff. They can get away for three months without too much formality and the extended seminars are designed to provide them with new contacts, new knowledge and a number of new research problems to take home. Extended seminars are devised in order to bring as many young scientists as possible from developing countries (usually of the order of 70 from about 25 developing nations) in contact with leading experts in their field for a period of time which would be sufficient, not only to enable them to up-date their knowledge in their subject, but also to help and encourage them in the difficult task of performing original and meaningful research under the guidance of experts. Many of them are able to carry out or initiate some research work during the courses. (As a rule, a large fraction of participants from developed and developing countries are men with research degrees already.) Moreover, at the Centre they also have opportunities to meet colleagues from countries which have similar problems in the development of science, and these meetings often result in constructive action and collaboration. Such extended seminars have so far been rotated mainly over solid state and nuclear physics. The following table gives a summary of the extended seminars organized since 1964. So far they have been attended by 2392 lecturers and participants. Financial support has always been given, preferably to participants from developing countries. Up to the present time, 832 physicists from 66 developing countries have attended ICTP seminars.

SUBJECT	DATE	NO. OF LECTURERS	NO. OF PARTICIPANTS
Plasma Physics	October 1964	21	50
Elementary Particles	May-June 1965	43	70
Nuclear Physics (Reaction Theory)	Oct-Dec 1966	32	102
Condensed Matter	Oct-Dec 1967	26	101
Contemporary Physics (Symposium)	June 1968	86	192
Nuclear Physics (Nuclear Structure)	Jan-March 1969	46	141
Condensed Matter	Jan-April 1970	23	105
Nuclear Physics	Jan-March 1971	30	116
Computing as a Language of Physics	August 1971	29	239
Condensed Matter	Jan-April 1972	23	116
Global Analysis and its Application	July-Aug 1972	70	218
Atoms, Molecules and Lasers	Jan-April 1973	28	72
Mathematical and Numerical Methods in Fluid Dynamics	Sept-Dec 1973	42	108
Nuclear Physics	Sept-Dec 1973	26	102
Surface Science	Jan-April 1974	26	109

The proceedings of these seminars have been published under the following titles:

- Plasma Physics. (640 pages)
- High-Energy Physics and Elementary Particles (1000 pages)
- Fundamentals in Nuclear Theory (1000 pages)
- Theory of Condensed Matter (1000 pages)
- Contemporary Physics Volume I (570 pages)
- Volume II (500 pages)

Theory of Nuclear Structure (960 pages)  
Theory of Imperfect Crystalline Solids (608 pages)  
Computing as a Language of Physics (616 pages)  
The Structure of Nuclei (600 pages)  
Electrons in Crystalline Solids (753 pages)

Other proceedings, i.e. Atoms, Molecules, Lasers; Global Analysis and its Applications; Mathematical and Numerical Methods in Fluid Dynamics; Nuclear Physics; and Surface Science are in preparation.

(b) The Fellowship Programme

Approximately 15 fellowships are awarded every year by the IAEA and UNESCO for post-graduate training and research to nationals from and working full-time in developing countries. The duration of the fellowships is about six to nine months; this can sometimes be extended for a similar period. Applicants are expected to have a university degree (M.Sc. or Ph.D.) with a good background in quantum mechanics, methods of mathematical physics, relativity theory, atomic and nuclear physics, etc., preference being given to those with research experience. Stipends are based on the rates of the United Nations Development Programme of \$450 per month.

(c-1) The Associateship Scheme

The ICTP Associateship Scheme was created in 1964 exclusively for the benefit of senior physicists from and working in developing countries. Normally, it gives them the privilege of spending, at a time of their choosing, six weeks to three months at the International Centre for Theoretical Physics, three times in a period of five years. This Scheme, which is complementary to the fellowship and visiting scientist programmes, is an attempt to lessen the brain drain from developing countries to more scientifically advanced ones by providing facilities for research in a very active centre.

The stay of Associates at the Centre is designed to keep them in the main stream of modern physics and stimulate their research and teaching when they return home.



Openings are announced by a circular letter from the Directors General of the IAEA and UNESCO to all Member States. Copies of this circular letter are also sent to all the physicists whose names are on the Centre's mailing lists. This letter invites prospective candidates to send details of their personal history and a statement of their research interests, professional responsibilities and other relevant details, together with six copies of their publications, to the Director of the ICTP. Letters of recommendation from two eminent scientists are also requested. No advertisement relating to the Associate Membership Scheme has been made since 1969. The Centre has, however, 150 files of suitable candidates who could not be appointed due to the lack of appropriate financial resources.

The Scientific Council of the ICTP examines the applications and makes recommendations for appointments.

No salary is paid to Associates, the home institution being expected to grant them paid leave of absence. Travel expenses and a subsistence allowance are paid by the Centre.

For several years, the Associateship Scheme was financed under the Centre's budget and the need for its expansion could not be satisfied with the limited resources available at the time when the IAEA and the Italian Government were the only sponsors of the Centre. The Ford Foundation was therefore approached as early as 1965 and two successive three-year grants were received from that organization.

The Swedish International Development Authority (SIDA) was also approached and their officials agreed in 1969 to support Associates from African countries and from India and Pakistan. SIDA support has been recently extended to nationals from Bangladesh, Sri Lanka, Chile and Cuba.

The United Nations Development Programme (UNDP) which, since 1971, finances the activities of the Centre in applied mathematics and computer science as well as in condensed matter physics, also supports Associates in mathematics and condensed matter physics who participate in research activities at the Centre. Since UNDP programmes are approved year by year, UNDP Associates have to be nominated for one year only.

Associates from Mexico are supported by their country.

In 1972, a Senior Associateship Scheme was introduced for the benefit of former Associate Members who have reached scientific international status and authority in their own countries. These scientists, while desiring to leave their position at the ICTP free for deserving junior candidates, are still interested in maintaining contacts with the ICTP and preserving the title of Associate. They are selected by the Scientific Council of the Centre. For each of these Associates, the Scientific Council has authorized a provision of US\$2,500 to be spent in visits to the ICTP over a period of five years.

(c-2) Junior Associates

The Junior Associateship Scheme was initiated in 1969 as a result of the financial support provided by the Ford Foundation grant. Experience during the first years of the Centre's existence revealed the need for a programme oriented to meet the problems of young theoretical physicists in isolated areas with very poorly developed scientific standards. The appointment of Junior Associates is therefore planned to meet the needs of such young scientists from developing nations in the lower stages of development, and/or isolated universities in scientifically advanced developing countries, and to help them in building up the first centre of crystallization of future scientific communities.

Candidates are normally selected from among the more outstanding but geographically isolated participants of the annual courses held at the Centre. Appointments have a duration of four years, provided the holder does not settle in an advanced country during this period.

Junior Associates have the following privileges:

- the possibility of ordering through the Centre each year books, journals or photocopies of scientific articles to the value of US\$200.-;
- their personal progress is followed by the Centre - with the help of the Directors of the ICTP activity attended - in order to assist them in obtaining a fellowship, should they wish to apply for one, at the ICTP itself or at other institutions;
- they are given priority for acceptance at the next extended course held at the Centre on the subject of their interest.

At the end of this four-year period and after consideration of the progress made during this period, Junior Associates become, automatically, candidates for an Associate Membership of the Centre.

(c-3) Group Associates

In those institutions in developing countries where a scientific community of high quality existed or had developed somewhat because of the presence of ICTP Associates, the need was felt to give to more than one or two privileged physicists the possibility of participating in the ICTP activities. In order to meet this need, the Group Associateship Scheme was created whereby a number of associateships were assigned to a certain institution. These associateships were to be used in rotation by several physicists approved by the Director of the ICTP and the Director of the Institution concerned. Since group associations are usually established with relatively advanced institutions, a matching of the costs is generally requested.

Four countries have a Group Associateship Scheme: Argentina, Brazil, India and Pakistan.

(d) The Federation Agreement Scheme

The Federation Agreement Scheme is aimed at building up relations of mutual co-operation between the Centre and scientific institutes or university departments in near and/or developing countries. By these agreements, the institutes can send young scientists of their choice to the Centre for up to a maximum number of days (40 days for nearby countries and 50 for others) per year. Normally the Centre pays a daily living allowance, while the Federated Institute provides for the travel cost. The number of Federated Institutes is now 26 in 17 countries. The results of these arrangements are very much appreciated, especially in countries of the Near East and the Mediterranean area, and requests to increase the number of man/days per Institution or to extend the federation link with other Centres have been received. Some Institutions have voluntarily raised contributions in local currencies convertible in Italian Lire through the Centre's sponsoring agencies in order to increase the number of visits to the Centre.

The effort of the Centre in its attempt to create a home for physicists from developing countries is illustrated in a graph (Fig. 1), which displays in absolute figures, as well as in percentage, their participation in the scientific activity. This participation has been measured in "man/month". Except for a small decrease in 1965-66 and in 1970, due to the plasma physics group which attracted many physicists from advanced countries (and not financially supported by the Centre), the share of developing countries in the research sessions of the Centre has been of the order of 60%. The financial effort of the Centre in favour of developing countries follows a similar pattern.

#### IV. THE SCIENTIFIC STAFF

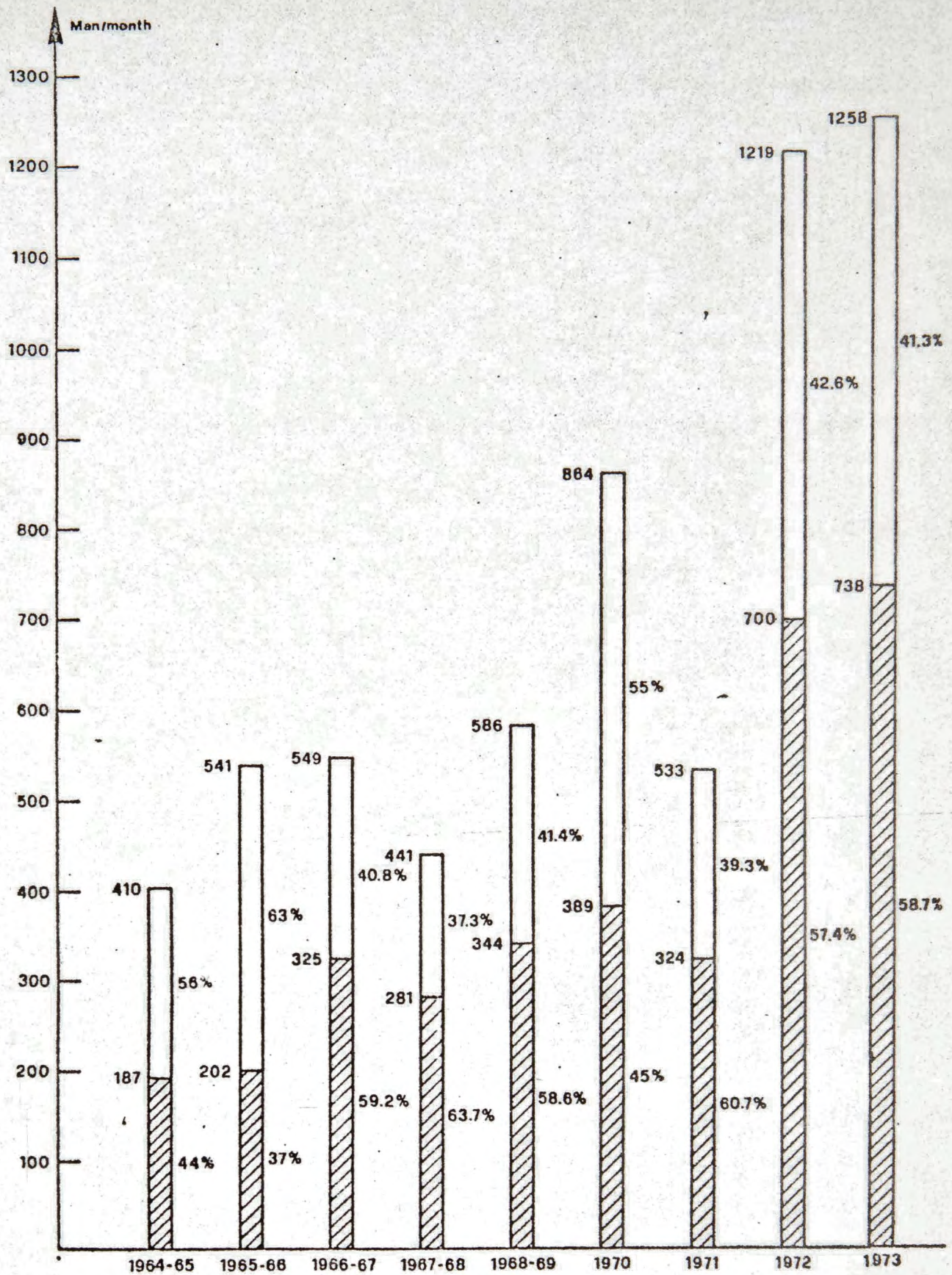
The major research activity is carried on by Visiting and Guest Scientists, Fellows and Associate Members, with a small core of permanent international Staff.

Besides the Director, Abdus Salam, and the Deputy Director, P. Budini, five other people constitute the permanent Staff of the Centre. They are J.A. Strathdee and the Consultants from the University of Trieste L. Bertocchi, V. Celli, L. Fonda and G. Furlan. Other part-time staff positions are offered to distinguished senior scientists who can spend long periods of time at the Centre. A.O. Barut (Boulder, Colo., USA), C. Fronsdal (Los Angeles, Calif., USA), and R. Oehme (Chicago, Ill., USA) have come under this category during the last academic years. In addition Dr. J. Sawicki was on the staff of the Centre for two years until his tragic death in 1968.


The Centre invites Senior and Junior Research Physicists from all Member States for periods ranging from a few weeks to nine months. Travel expenses are sometimes covered by the Centre. The intention is to gather together specialists and promising young research workers in some of the leading fields of theoretical physics, in order to create a highly productive and qualified environment for the young Fellows from developing countries.


#### V. ACTIVITIES FROM 1964 TO 1973

(a) 1964-65 - The first academic year started with a one-month seminar in plasma physics. This seminar was co-directed by Professors



Participation in the research activities of the Centre expressed in man/month.

 Number of man/months for physicians from developing countries.

 Number of man/months for physicians from advanced countries.

(Percentage for each category is also shown)

B.B. Kadomtsev, N. Rosenbluth and W.B. Thompson. A fruitful co-operation between the American, the European and the Soviet schools was then initiated, which developed into a much closer one in 1965-66. A pattern of presenting progressively advanced topics after an introduction was then established and has been followed in all the courses which have been held since. Fundamental processes, plasma waves, magnetohydrodynamics, oscillations, equilibrium theory, confinement, and turbulence were reviewed by 21 lecturers. The number of participants was 50 from 16 countries.

The research activity of the Centre during that year was mainly concentrated on high-energy physics. Various aspects of symmetries in particle physics and applications of group theory were then studied, as well as S-matrix and other scattering problems.

Another seminar was organized in May/June, with the scope of reviewing the progress made in elementary particle physics since 1962, attended by 43 lecturers and 70 participants representing 29 nationalities. Altogether, 31 Visiting and Guest Scientists, 27 Fellows, one Associate Member and 24 Guest Lecturers came to the Centre during the first year of operation.

(b) 1965-66 - The academic year 1965-66 was basically dedicated to high-energy and plasma physics. The plasma physics group, under the leadership of Professors M.N. Rosenbluth and R.Z. Sagdeev, investigated the theory of plasma stability, the instabilities in inhomogeneous plasmas, the quasilinear theory of "whistlers" and shock waves in collisionless plasmas.

High-energy physics was essentially the continuation of work started the previous year, i.e. relativistic generalization of SU(6), non-compact Lie groups, and potential scattering. Some aspects of quantum electrodynamics, dispersion relations and algebra of currents were also studied.

In that year, 66 Visiting Scientists, 19 Fellows, two Associate Members and 28 Guest Lecturers took part in the activities of the Centre.

(c) 1966-67 - The academic year 1966-67 started with an extended course on Theoretical Nuclear Physics, held from 3 October to 16 December.

The organizers were the late Professor A. de-Shalit (Israel) and Professor C. Villi (Italy). The syllabus of the course included mainly lectures on collision and reactions theory, direct interactions, group theory and nuclear structure.

The course on Nuclear Physics was attended by 32 lecturers and 102 participants. Research in that field was continued and gradually expanded under the leadership of the late Professor Sawicki.

However, the bulk of the work concerned high-energy physics, on which subject numerous papers on field theory, infinite-component field theories, bound states and quark models, Regge poles, symmetries and group theory, dynamical problems, superconvergence and current algebra were issued.

During that year a new scheme of co-operation between neighbouring institutes was initiated. The so-called Federation Agreement allowed 25 visitors from these institutes to spend short periods at the Centre and make direct contact with the staff of the Centre. In addition to the participants in Nuclear Physics, 28 Visiting Scientists and Associate Members, 26 Fellows, 11 Consultants and 28 Guest Lecturers came to the Centre during the year 1966-67.

(d) 1967-68 - The 1967-68 academic year was again opened with an extended course, which lasted from 3 October until 16 December. Its subject was a review of condensed matter, liquids as well as solids. The organizers were Professors J.M. Ziman (UK), F. Bassani (Italy), and J. Caglioti (Italy); and 26 lecturers and 101 participants took part in the course. The programme included lectures on group theory, many-body theory, liquid state, superfluidity, lattice dynamics, liquid metals, phonon-phonon and electron-phonon interactions, etc.

But the great event of that academic year was the International Symposium on Contemporary Physics. The Symposium was an attempt to review, discuss and compare all disciplines of modern theoretical physics, such as nuclear and high-energy physics, condensed matter, astrophysics, plasma physics, relativity, statistical mechanics and axiomatics.

The Symposium was attended by 278 physicists from 49 countries, including 8 Nobel Prize winners.

During the academic year, the Ford Foundation grant allowed the Centre to increase the number of Associate Members and to enlarge the Federation Agreement programme. Nuclear physics was maintained during the whole year as well as high-energy physics. These groups produced new results in microscopic nuclear spectroscopy, sum rules, quark model, quantum field theory, scattering theory and algebra of currents.

The number of physicists who participated in the Centre's work was as follows: 103 Visiting Scientists and Associate Members, 20 Fellows, 14 Guest Lecturers and Consultants and 34 Visitors from Federated Institutes.

(e) 1968-69 - At the beginning of the academic year 1968-69, the work of the Centre was again focused on nuclear and high-energy physics. A second course on nuclear physics was held under the leadership of Professors G. Alaga (Yugoslavia) and L. Fonda (Italy), from 7 January to 31 March 1969. This course was attended by 187 lecturers and participants.

During the summer period the nuclear physics group was strengthened and reached the highest number since its establishment. The high-energy physicists also increased their number during that period. Two informal meetings - one on dynamical groups and the other on renormalization theory, were held in June and August, respectively. The research work concentrated on the microscopic theory of nuclear structure and few-nucleon problems, non-linear Lagrangians, current algebra, hadron scattering, the Veneziano model, the quark model and on applications of group theory.

An important factor in the life of the Centre was the generous grant of the Swedish International Development Authority in favour of African physicists, which provided the Centre with new means to help developing countries.

(f) 1970 - A second course in condensed matter entitled "Winter College on the Theory of Imperfect Crystalline Solids" was held from 12 January until 10 April 1970. The course was organized by Professors G. Chiarotti (Italy), F. Garcia-Moliner (Spain), S. Lundqvist (Sweden) and J.M. Ziman (UK). It was attended by 128 lecturers and participants.



A workshop in solid state physics continued until July the activities of the Winter College under the leadership of Professor Lundqvist. Topical meetings on the quantum theory of the disordered state and on the many-body theory of singular effects and satellite structure in solids were organized by this workshop in April and in July, respectively.

As in 1965-66, a plasma physics group led by Professor B.B. Kadomtsev (USSR) and M.N. Rosenbluth (USA) worked from April to August. A panel on the International Co-operation in Fusion Research and its Applications was held at the Centre in June.

The elementary particle physics group was active from the beginning of the year and was strengthened again during the spring and summer. A topical meeting on the Frontiers of Science was organized in June.

As in 1969, the Swedish International Development Authority provided financial support to African Associate Members and participants in the Winter College. The Ford Foundation made a second grant available for financing the Associate and Junior Associate Membership Scheme over a three-year period. The Swedish Nathorst Foundation made funds available for supporting stays of Swedish scientists at the Centre. The German Government also financed short stays of German physicists at the Centre. The Ruder Bošković Institute in Zagreb made the equivalent of US\$1,200 available to the Centre for enlarging the existing Federation Agreement between the Institute and the Centre. The Division of Budget and Finance of the IAEA made possible the conversion of Yugoslav currencies to convertible ones. As in 1969 also, the Grupo Interuniversitario de Fisica Teorica de Altas Energias supported the stay at the Centre of Spanish physicists.

(g) 1971 - The third course on nuclear theory was held from 13 January to 12 March 1971 with Professors L. Fonda (Italy) and G. Ripka (France) as directors. It was attended by 146 lecturers and participants. A workshop under the leadership of Professor G. Ripka and in close collaboration with the staff of the University of Trieste was active until July.

In 1971, the United Nations Development Programme (UNDP) awarded to the Centre a grant in support of its activities in condensed matter and another with UNESCO as the Executing Agency, for launching research and training-for-research activities in applied mathematics

and computer science. A workshop in solid state physics was therefore organized from 1 July to 30 September 1971. It was directed by Professors S. Lundqvist (Sweden) and N.H. March (UK). The programme in mathematics sponsored by UNDP was the Seminar Course on Computing as a Language of Physics, held in August 1971. It was organized by Professors Abdus Salam (ICTP), L. Bertocchi (Italy and ICTP), S.J. Lindenbaum (USA), and K.V. Roberts (UK), and was attended by 239 scientists.

Research in high-energy physics was active throughout the year. Two topical meetings relating to this discipline were held: one on electromagnetic interactions ( 21 - 26 June) and one on gravitation and field theory (13 - 16 July). Grants from the Swedish International Development Authority (SIDA) in support of the Associate Membership Scheme and of participants in extended courses were also received.

(h) 1972 - The third course in condensed matter was held from 10 January to 15 April 1972. This time the subject under extended and thorough review was electrons in crystalline solids. The programme of this extended course was planned by the Advisory Committee on Solid State Physics (Professors G. Chiarotti (Italy), F. Garcia-Moliner (Spain), S. Lundqvist (Sweden), N.H. March (UK) and J.M. Ziman (UK)). Altogether 139 lecturers and participants took part in this activity, which was sponsored by SIDA and UNDP. A workshop on the same subject was held from April to August 1972. The second UNDP project was implemented in July-August. Its theme was global analysis and its applications. The summer course was co-directed by Professors M. Dolcher (Italy), J. Eells (UK) and E.C. Zeeman (UK). The programme of this meeting included an introductory part followed by a research programme. A small meeting on neural networks was also organized in this framework. Some 218 scientists took part in the Summer College on Global Analysis and its Applications.

In high-energy physics, research was carried out throughout the year. Special lectures in phenomenological elementary particle physics were held from October to December 1972.

A Symposium on the Physicist's Conception of Nature was organized by the Universities of Texas and Trieste and held at the Centre from 18 - 25 September 1972.

(i) 1973 - The year started with a Winter College on Atoms, Molecules and Lasers under the leadership of Professors A. Kastler (France),

B. Edlen (Sweden), I. Kovács (Hungary) and B.L. Moisewitsch (UK). The Winter College, which was held from 17 January to 10 April 1973, was attended by 100 lecturers and participants.

A workshop on solid state physics assembled from July to September 1973, headed by Professors N.H. March (UK) and S. Lundqvist (Sweden). This activity was supported by UNDP.

Other activities during the summer included a research session on theoretical astrophysics and on relativity with Professors M. Hack (Italy), A. Cavaliere (Italy), D.W. Sciama (UK), and F. Pirani (UK) as main leaders; a working group in plasma physics with Professors R.Z. Sagdeev (USSR) and M.N. Rosenbluth (USA) as directors, a Summer School on the Physics and Mathematics of the Nervous System with Professors W. Güttinger (Fed. Rep. of Germany), J. Taylor (UK), M. Conrad (Fed. Rep. of Germany) and M. Dal Cin (Fed. Rep. of Germany) as organizers. This summer school was sponsored by the Volkswagen Foundation. In high-energy physics, in addition to the normal through-the-year activity, a topical meeting on weak interactions was held from 26 - 29 June 1973.

The activities during the autumn included an extended seminar on nuclear physics headed by Professors G. Ripka (France), M.K. Pal (India) and L. Fonda (Italy and ICTP), and an Autumn College on Mathematical and Numerical Methods in Fluid Dynamics, organized by Professors T.B. Benjamin (UK), J.L. Lions (France), G. Stampacchia (Italy) and G.I. Marchuk (USSR). This College was sponsored by UNDP. In both programmes, 100-120 lecturers and participants took part.

(j) 1974 - The fourth course on condensed matter was held from 16 January to 10 April 1974 and dealt with Surface Science, a subject chosen for its topicality and technological importance. Its programme was set up by the Advisory Committee on Solid State Physics. This course, sponsored by SIDA and UNDP, was attended by 135 lecturers and participants.

A workshop on solid state physics, headed by Profs. S. Lundqvist (Sweden), V. Celli (Italy and ICTP) and N. March (UK) is being organized from 15 June to 15 August 1974. A topical meeting on the applications of the renormalization group to statistical physics will take place on 29-30 July 1974.

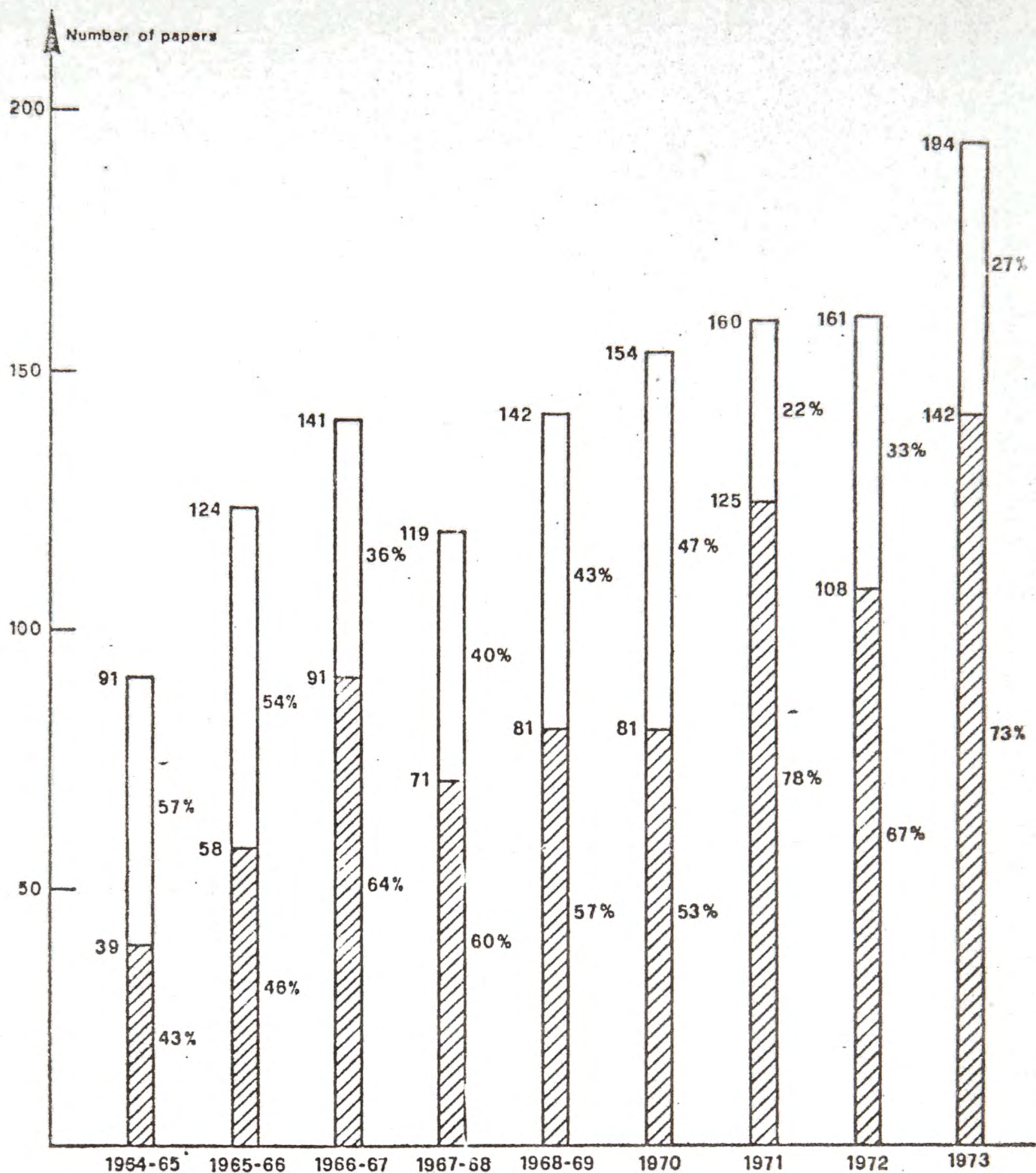
In high-energy physics, research has been active since the beginning of the year. A topical meeting on the Physics of Colliding Beams, with an attendance of 191 participants took place on 20-22 June 1974. A short meeting on the applications of the renormalization group to high-energy hadron scattering will be held on 31 July and a topical meeting on High-energy Collisions Involving Nuclei will be held from 9 to 13 September 1974.

Other activities planned for late 1974 include a workshop in astrophysics in September, and an Autumn Mathematics Course on Control Theory and Topics in Functional Analysis (11 September to 29 November 1974). The Centre will also host a meeting sponsored by UNESCO on Science and Youth in September 1974.



## VI. MAJOR ACHIEVEMENTS

Leaving aside the social aspect of the impact of the Centre on collaboration between scientists from countries with different viewpoints and stages of scientific knowledge, the major achievements of the ICTP in theoretical physics are: contributions to symmetries, mathematical studies of non-compact groups  $[SL(6,C), U(12), U(6,6)]$  partial wave analysis, reggeization of higher symmetries, renormalization of non-polynomial Lagrangian theories, infinite-component fields, and current algebra, phenomenological analysis of strong interaction data based on Veneziano and Regge models, and finite-energy sum rules. In nuclear physics, studies on the microscopic structure of nuclei, and in plasma physics, work on non-linear phenomena have been the main contributions from the research groups of the Centre.

It is gratifying to observe the share of physicists from developing countries in the published results. Fig. 2 shows the number of papers published by them, in comparison with the total number of publications. The total number of physicists who attended the seminars and who participated in the research activities every academic year is shown in Fig. 3.

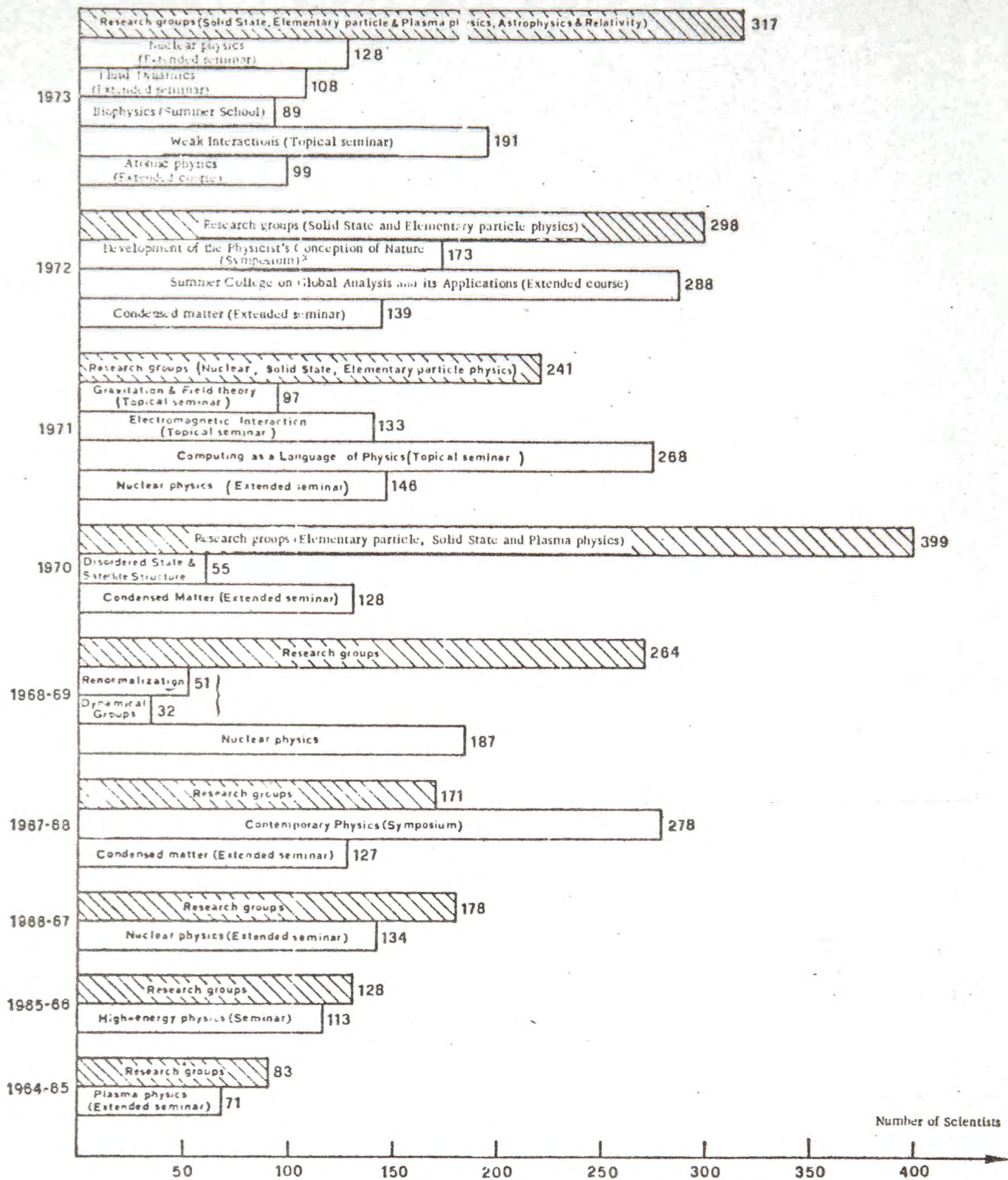


Number of ICTP preprints Issued every academic year.

 Produced by physicists from developing countries, alone or in collaboration with others.  
 Produced by physicists from advanced countries.

(Percentages are also shown)

FIGURE 2



Number of scientists who have worked at the Centre every year.

- Physicists who participated in international courses, informal meetings and symposium.
- Visiting and guest scientists, fellows, Associates, visitors from federated institutes, etc., who participated in the research sessions.

AN INTERNATIONAL APPROACH TO RESEARCH IN HUMAN REPRODUCTION  
AND FAMILY PLANNING: WHO'S PROGRAMME.

I. INTRODUCTION

The last decade has witnessed a great surge in awareness of problems relating to human reproduction, particularly to the regulation of fertility. Biological, social, cultural, economic and political considerations are all involved, but the health sector has been one of the most immediately affected since it has been expected to respond instantly to growing demands for services. Although many of these new programmes have achieved a certain measure of success, numerous problems have emerged to which the solution could only hope to be found through research.

How is one to develop methods, approaches and service structures that could potentially reach on a continuing basis most persons of reproductive age in a community? Besides the difficulties encountered in all forms of preventive medicine, methods of fertility regulation pose problems for research seldom encountered with other therapeutic agents: they may be used over very long periods of time, with little or no medical supervision; many of them interfere with normal body processes; a wide choice of methods is required to meet the varying needs of individuals.

Worldwide interest in these problems has led to the development of one of the World Health Organization's larger research programmes, covering all areas of research in human reproduction, although the emphasis is greatest on various aspects of family planning. Within the overall programme research is promoted on the biomedical, epidemiological and operational aspects of family planning, sterility, pregnancy, lactation, and other aspects of reproductive health and disease. Strengthening of resources for research, both manpower and facilities is carried out as an integral part of the research programme.

The research programme is "mission oriented", focusing on issues that have arisen in national family planning programmes but that have wide relevance and international applicability. The nature of the problem is such that a multidisciplinary approach is required



be it for the improvement or development of contraceptive technology, new approaches to the delivery of family planning at the community level, or study of the inter-relation of biological and social components of human reproduction in different populations.

The forms vary in which WHO assistance is given: setting up and funding "Task Forces" for collaborative studies that focus on the solution of specific research problems; providing support for research, both in the form of technical advice in the planning and implementation of studies, and salaries and purchase of equipment; strengthening an existing research institution, or building up a new one. Recent advances in research on human reproduction and family planning are reviewed on a continuing basis by the Organization; reports are published and receive wide distribution.

Although this approach to research support does not differ in principle from that which guides WHO's research programmes in other fields, the significantly greater funds available (1973: \$8.5 million; 1974: \$11 million) have allowed a slightly different approach to be taken to the strategy and administration of the programme. For example, before developing a new major line of activity, it has been possible to carry out a feasibility study on a global scale, with extensive consultations with research policy makers and administrators and visits to scientists and research institutions.

Having at its disposal larger funds, the programme has been able to open up new lines of research which would not have been accessible to scientists had only small amounts of "seed-money" been available. This is not to denigrate in any way the value that seed-grants have had in other aspects of WHO's research programme, in drawing attention to important research areas and, in many instances, attracting funds to the grantees from other sources. At the same time, the magnitude of funds has permitted the building up of research institutions: by creating in already established centres multidisciplinary teams intended to provide a "critical mass" on reproduction research; and, in relation to family planning programmes in developing countries, by setting up national resources for research. It has also been possible to apply or develop modern techniques of management to assist in the planning and monitoring of the more than 300 projects in the several priority areas of the programme.

## 2. RESEARCH PROGRAMME: PRIORITY AREAS FOR RESEARCH

Each section in the following text relates to a priority area for research in WHO's programme. It presents first the problem to which the research is addressed, describes in detail a few projects selected from among those supported by WHO in the specific area, and discusses some of the obstacles encountered and lessons learnt.

## 2.1. Methods of fertility regulation

Three main considerations affect the individual's or couple's choice and continued use of fertility regulation: its effectiveness, the likely side effects, and other characteristics that affects its acceptability. The latter include its actual form, i. e. whether it is an oral or injectable drug, or one of many types of devices; the timing of its use, i. e. whether immediately before or after intercourse or dissociated from it entirely; the duration of effect, including its reversibility; and the sex of the user. Social and cultural considerations, as well as cost, also play a part in influencing acceptance or successful use, e. g. a method such as the I. U. D. which involves a gynaecological examination may be unacceptable to certain cultures.

Although presently available methods represent a considerable advance over the past, they remain relatively crude, for many methods <sup>are</sup> associated with unacceptable side effects on health, and as a whole they fail to meet the varied requirements of consumers and services in different countries, particularly developing ones.

For these reasons, two of the priority areas in WHO's research programme relate to improvement of existing methods and assessment of their suitability in different populations, and to development of new technology.

### 2.1.1. Existing methods of fertility regulation

The modern methods of fertility control, especially the hormonal steroids and IUDs, have been developed and tested in women from more developed countries. It has been assumed that the same dosage of these drugs or shape of the devices would be equally suitable for women from less developed countries in spite of the fact that these women differ in body size, diet, childbearing patterns, work habits and genetic constitution. Moreover, large numbers of them exhibit varying degrees of nutritional deficiencies and are prone to many infections and infestations. Lack of national research and expertise on these questions has held back authorities from making available a number of contraceptive modalities for fear of their possible ill effects. This reluctance has been accentuated by the ambiguous and harmful effects found at times in some Western women.

Considerable effort has been directed during the past two years in the WHO programme to the assessment of currently available methods through clinical trials and field studies. Results become available within a one- to three-year period and thus provide immediate feedback to the national family planning programmes.

#### 2.1.1.1. Research problems and projects

##### (a) Hormonal contraceptives

One of the most fundamental requirements for assessment of the effects of oral and injectable contraceptives is baseline data on normal levels of reproductive hormones, and

on changes in these levels following use of different preparations. Such endocrinological parameters have not been determined in populations other than Western women, and WHO-sponsored projects, for instance in Egypt, Iran, Pakistan, Thailand and Turkey, are providing such information for the first time.

Other studies are investigating the frequency and patterns in populations of several developing countries of side effects that have been reported in Western women. For example, the effects on carbohydrate metabolism and liver function of combined oral preparations, low dose progestogens and an injectable contraceptive are the subject of several studies. Preliminary analysis of the data from one of the Thai studies shows that the risk of liver damage does not appear to be higher in Thai women. Other common side effects in Western women which have led to discontinuation of use of hormonal steroids are increased blood pressure and weight gain. Their possible occurrence in women in developing countries is being investigated through analysis of the records of family planning clinics, and through in depth metabolic studies. The importance of lactation to infant survival in developing countries has led to WHO studies on the quality and quantity of the milk of mothers receiving hormonal contraceptives.

Many family planning authorities have been deterred from using the "pill" in their programmes because of the publicity given to thromboembolic incidents as a side effect of these drugs. This complication may not, however, be an important one in Eastern women where there is a clinical impression that thromboembolism is rare. A WHO study is currently attempting to document this issue more accurately.

The widespread occurrence of malnutrition and endemic parasitic disease has caused administrators of family planning programmes to request guidance on the suitability for their programmes of hormonal contraceptives. A multi-centre collaborative study, using a common protocol, will investigate the effects of steroidal contraception in malnourished women, as measured by some aspects of the metabolism of proteins, lipids, carbohydrates, vitamins and trace elements. The high level of schistosomiasis in Egypt has led to the elaboration of a study to examine whether additional risks to liver function exist when hormonal steroids are taken by infested women.

The whole question of possibly delayed return of fertility after cessation of use of steroid contraception, particularly in the case of injectable preparations, has been of considerable concern. The problem is being studied in prospective endocrinological studies, by follow-up of return of menses and pregnancy in Pakistani women, and by analysing a large collection of records in northern Thailand.

Another frequently raised question is whether hormonal steroids increase the risk, for the "pill-user", of later having a live-born child with chromosomal abnormalities.

Preliminary results that have recently become available, including some studies supported by WHO, do not suggest a greater risk.

(b) Intrauterine devices

Comparative studies on the effectiveness, side-effects and continuation rates of copper-bearing IUDs and plain plastic devices of different designs are being conducted in several projects supported by WHO in India and Pakistan. A two-year prospective study of three IUDs is being carried out in a rural area of Thailand by a WHO research team. A possible toxicological hazard from copper-bearing IUDs may lie in systemic absorption and storage in the liver. In view of suggestive evidence from studies in rats, an investigation in baboons is being supported by WHO in Mexico, Sweden and the United States of America.

(c) Sterilization

During the past few years, there has been an increase in a number of countries in demands for tubal occlusion and vasectomy. Different approaches to sterilization - abdominal and vaginal - and different techniques - surgical and endoscopic - are being studied with WHO support in the context of national family planning programmes. The relative merits of local and general anaesthesia and their effect on somatic sequelae constitute an important component of these studies.

The possible psychological consequences in men and women of sterilization are far from being adequately documented. Health administrators with responsibility for family planning have become aware of the need for screening instruments that would identify individuals who might suffer from such adverse effects. A research project has therefore been started in Singapore to assess the incidence of post-operative psychological complications, their nature and the predictive power of the screening instrument. The screening instrument is based on five clusters of variables relating to motive for sterilization; knowledge of the operation; individuals present life situation; conscious and unconscious concepts of sterility, sexuality and gender; and past reaction to traumatic events.

2.1.1.2. Obstacles encountered and lessons learnt

The greatest difficulty encountered in carrying out such studies, which must be done locally, is shortage of manpower and necessary facilities. Scientists with the required expertise in clinical pharmacology, obstetrics and gynaecology, epidemiology, biostatistics, etc. are scarce all over the world, but particularly in developing countries. Clinical trials of existing methods of contraception seem so far to have held little appeal to scientists, in spite of the intellectual challenges they offer. Thus both consultants and training facilities are scarce. One solution adopted has been to put into a developing country a WHO research team, consisting of international and counterpart national staff, to carry out research and provide research

training.

Studies of the endocrinological and metabolic effects of existing contraceptives require sophisticated laboratory facilities that are usually not available in developing countries. Purchasing of this costly equipment by WHO has facilitated the selection of equipment most appropriate to local conditions, at lower prices, and nearly always allows customs-free importation through WHO agreements with governments. It has also in part helped to solve the difficult problem of ensuring maintenance of the equipment, by insistence on the firms providing adequate guarantee of maintenance and spare parts.

The identification of the institution, within a country, in which these resources might best be developed, has in certain cases proven difficult. The scientific criteria that need to be met are sometimes not reconcilable with the political considerations that may influence the local authorities' advocacy of a particular institution. There may even be disagreement between different government bodies such as the Medical Research Council, the Ministry of Health, the Ministry of Education.

The building up of these facilities takes time. Continuity of support and stability of policy are needed from the institution, the government and the source of external assistance. Fluctuations in governments' attitudes to family planning have had their repercussions on research as well as on other aspects of the family planning programme. At other times, governments have changed the priority they place on research, and funding has been affected. There has also been some instability in the source of funds (United Nations Fund for Population Activities) upon which WHO has had to rely to build up these facilities, which do not come under the Organization's Regular Budget activities.

It is often suggested that these costly facilities might be established on a regional basis, and that one laboratory could serve several countries. There is both political and scientific resistance to this concept, and the logistics of the transport of large numbers of blood and urine samples does in fact prove difficult.

For certain questions requiring comparative study in several countries, such as the effect of the pill in the presence of nutritional deficiencies, lack of experience in following accurately a common study protocol has been a considerable stumbling block, for instance in relation to observing correct sampling techniques, conducting unbiased interviews, maintaining quality control in laboratory work, and obtaining the very high follow-up rates of patients required for meaningful interpretation of the data. Maintenance of the required standards has called for considerable input of staff and consultant time, but has had a positive training value.

## 2.1.2. Development of new methods of fertility regulation

### 2.1.2.1. Research problems and projects

Every new advance in contraceptive technology has introduced family planning to additional groups in the population while still, however, failing to meet the personal requirements of others. In 1972, therefore, the Organization expanded its programme of research to develop new, safe, acceptable, and effective methods for the regulation of human fertility. Specific methods that are being developed in presently ongoing collaborative Task Forces, involving 175 scientists in institutions in 31 countries, include:

- drugs: pills for men, new injectables for women, agents (prostaglandins) for the safe termination of pregnancy.
- devices: used to deliver contraceptive drugs locally and at a constant release rate, to the uterus, cervix or vagina; those inserted in the uterus will also carry drugs to reduce pain, bleeding and possibility of expulsion.
- procedures: to simplify sterilization techniques in women, including systems of delivering chemical occluding methods to the tubes that would not involve surgery and could be used by non-physicians.
- "vaccines" for fertility control in men and women.
- simple kits and techniques for the prediction and detection of ovulation for couples using the rhythm method of birth control

Projects in these collaborative efforts are directed to early or later states of research on specific methods. This may be illustrated by reference to Figure 1 which shows the various steps in the development of a continuously administered contraceptive drug. The WHO projects may relate to one or several of the activities: in some instances, a compound may already have been developed by a pharmaceutical company, and WHO support is given to carry out the clinical trials while the company takes responsibility for the other steps, e.g. short- and long-term animal toxicity studies. In other cases, the WHO projects begin at the first step, the elucidation of physiological mechanisms, and undertake either the complete development of the method or share the development costs by arranging collaborative projects with companies and institutions receiving funding from other sources. A variety of management and systems analyses techniques are being applied in these projects to derive estimates of time, cost, and probabilities of success.

Social scientists are contributing to the exploration of further potential leads for new birth control methods through a collaborative effort to define the characteristics of potential methods of fertility regulation that might affect their acceptance in various socio-cultural settings. Biomedical scientists will then be asked to translate these socio-cultural

specifications into therapeutic methods. Research is starting on the value ascribed in different communities to reversibility of contraceptive action, the importance of such side effects as amenorrhoea, the potential use by men of pills or injections for the control of their fertility, and the characteristics of various indigenous methods of fertility regulation.

Other problems that require to be overcome in developing new methods are lack of suitable animal models for reproduction research in general, and for the assessment of mutagenicity, carcinogenicity and teratogenicity, and disagreement on procedures for the testing in man of new agents. These difficulties have led to increasing pressure to formulate guidelines that are scientifically sound, economically acceptable, that safeguard the health of the public, and do not hamper active research in the field. WHO has convened two international meetings on these problems. The first (held in Sukhumi, USSR) focused on the use of non-human primates for research in reproduction<sup>1</sup>, the other on pharmacological models in contraceptive development<sup>2</sup>, brought together some 60 scientists from national drug regulatory agencies, drug companies, and academic institutions. It provided the first opportunity for the three groups that are principally concerned with contraceptive development to meet. Some support has also been given by WHO to research on the possible value of animal species that have so far not been used for studies in reproductive biology.

A network of WHO clinical research centres on human reproduction has been established to provide a ready facility for testing with common protocols new methods emerging from the collaborative research projects described above, or methods from other sources (other organizations, individual scientists, industry). This international mechanism should help avoid the problems encountered in the past with clinical trials of contraceptive methods, in which results obtained in Western subjects were unjustifiably generalized to other populations, or in which data derived from studies based on different protocols could not be compared.

Another mechanism for stimulating research on new methods of fertility regulation is support to relatively large groups of scientists in academic institutions identified for their interest and achievement in this area of research. WHO support aims at fostering the multi-disciplinary aspect of their work and expanding their present research and training activities. Although there are precedents in such fields as cancer research, neurobiology and molecular

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1 The Use of Non-Human Primates in Research on Human Reproduction: WHO Symposium, Sukhumi, 1971.

2 Pharmacological Models in Contraceptive Development: WHO Symposium, Geneva, 1973.

biology, this approach has hardly been attempted so far in reproduction research. Four institutions have been designated WHO Research and Training Centres in Human Reproduction.

#### 2.1.2.2. Obstacles encountered and lessons learnt

This particular aspect of WHO's research programme is only two years old, and it is clearly too early to judge it in terms of output. Some positive lessons have been learnt, some obstacles have emerged. Probably the most striking of the latter has been the reluctance of university scientists from many disciplines to commit themselves to "mission-oriented" research. This applies not only to biological and physical scientists but also to the social scientists needed for the programme.

Considerable staff effort has gone into showing the intellectual challenge that the mission-oriented and collaborative effort can offer, and that such research includes study at the fundamental level - albeit on clearly defined issues - as well as at the applied. It has thus been possible to bring an increasing number of scientists into the programme. An added element of attraction for many scientists has been the opportunity afforded by the WHO programme to work with high level scientists from other countries on socially relevant problems. Similarly, the programme has drawn collaboration from industry that might not otherwise have prevailed between competing firms. Certain firms have, for example, provided compounds for further development that might otherwise have remained shelved.

Scepticism was expressed, when the programme was first mooted, on the ability of an international bureaucracy such as WHO to contribute directly to the complex process of drug and device development in fertility control. Figure 1 shows the many steps involved that require planning and monitoring, but does not reflect the variety of institutions and agencies that need to be involved. Did an international civil service have the necessary vision, the capacity for taking rapid decisions, the scientific knowledge to control such a programme? As was mentioned above, it is too early to give a definite answer to these questions as far as results go. However, experience to date shows that the structure of WHO allows the setting up in a relatively short period of time a multinational, multidisciplinary research network of high calibre. The use of management techniques is proving useful in monitoring the large number of projects involved.

A major factor in ensuring the success of the programme will be the ability to continue to attract staff with the combination of scientific knowledge, managerial ability, commitment to the development of therapeutic agents, a multidisciplinary background, a capacity for team work, and an international sensitivity and outlook. There are few such individuals, and though the conditions of work at WHO are good, some qualified candidates have not joined because they could do better elsewhere financially and in terms of long-term security.



This particular part of WHO's research programme is supported entirely from special voluntary contributions from several governments and one private foundation. The donors have allowed great flexibility in the administration of the funds, and certain of them, realizing the time required for the development of any new contraceptive agent, have indicated three to five year funding commitments. Although the donors have accepted one of the basic premises of the programme, that research should be carried out wherever it can best and most quickly be done, it has been a source of disquiet at times that substantial funds have either found their way back to the actual donor countries, or to scientists of other developed countries, especially the United States that is not contributing financially to this programme.

## 2.2. Abortion

### 2.2.1. Research problems and projects

In countries which in recent years have legalized termination of pregnancy, authorities have raised many questions such as the relative merits of various techniques for termination at different stages of pregnancy, the dangers, if any, of repeated abortion, the staff and facilities required for the different methods, the interrelations between provision of abortion and use of contraceptive methods.

Techniques for the termination of pregnancy are being assessed in multi-centred studies in relation to immediate complications and long-term sequelae. For example, a therapeutic trial is comparing in Singapore and Yugoslavia the rate and nature of short-term (up to 28 days) complications when termination is performed by vacuum aspiration under general or local anaesthesia, as an outpatient or inpatient procedure. The study will be extended to India in 1974. Investigations of the long-term sequelae from legally induced abortion began in 1974 in seven countries to determine whether there is an increased risk of subsequent infertility, premature delivery, or of foetal wastage. The demand by many women for sterilization at the time of abortion has raised the question as to whether the two procedures should be carried out simultaneously or whether sterilization should be delayed for some time. The problem is the subject of a WHO project.

The provision of termination of pregnancy has made demands on the health services that have raised various operational questions. Research is planned on several of these issues such as : the social and psychological characteristics of women that influence their decisions to resort to abortion; alternative ways of organizing referral and care during termination of pregnancy; various approaches to the provision of other methods of birth control after abortion.

### 2.2.2. Obstacles encountered and lessons learnt

In spite of the complexity of the subject, it has been possible to develop this part of

the programme in a relatively short period of time because of the small number of experts from different public health and social science institutions who were interested in the question were glad to come together to plan a concerted international effort. In an area where research has sometimes been subject to bias (either for or against abortion), the research protocols designed in the WHO programme have been welcomed by collaborating centres.

### 2.3. Patterns of family formation and health

#### 2.3.1. Research problems and projects

Different patterns of family formation, in the sense of timing and spacing of births and the total size of the family, are associated with different risks to the health of mothers and children and other members of the family. Studies, carried out so far in developed countries, have shown the considerably higher mortality and morbidity of older (over 30), higher parity (over 4) women and their offspring. This in itself constitutes a solid rationale for family planning. In order to validate these findings in developing countries, collaborative studies on relationships between family formation and health were started by WHO in 1970 in India, Iran, Lebanon and Turkey. They were rapidly extended to other countries owing to the interest they generated in both countries with ongoing family planning programmes (e.g. Philippines, Pakistan and Egypt) and others with little or no commitment to family planning (e.g. Colombia and Syria).

In these studies, social, economic, cultural and health data are collected through interviews; gynaecological and paediatric examinations and psychological tests are also performed. These data provide "benchmarks" on morbidity associated with unregulated reproduction as well as on attitudes to and acceptance of the practice of family planning. Another aspect of the studies is concerned with the extent to which decisions regarding family planning are influenced by real or anticipated infant and child mortality. Data from five of the collaborating study centres have been analysed.

#### 2.3.2. Obstacles encountered and lessons learnt

Research of this kind is difficult since it is essentially multifactorial, with the biological intimately related to the social, cultural and economic. This makes it necessary to collect a great deal of data which requires multivariate analysis. Access to large computer facilities is essential for centralized data analysis. The data themselves are difficult to collect since much of the information is of a personal nature. Use of local personnel is indispensable, and the studies require the combined efforts of professional and field staff from several disciplines.

Despite the apparent lack of scientists with experience in this particular area of research, it was found possible to draw together capable multidisciplinary groups, challenged

by the subject and who welcomed guidance and coordination from an international organization such as WHO. These groups are now able to proceed to more detailed study of some of the hypotheses that the preliminary investigation is suggesting as well as to other problems in the fields of family planning.

## 2.4. Operations research in family planning

### 2.4.1. Research problems and projects

A variety of questions arise in the planning, implementation and evaluation of family planning programmes. They range from very specific points regarding the delivery of care at the consumer level to broad questions of organizational strategy. The WHO research programme follows two main approaches:

#### (a) Programme trials of methods of fertility regulation

The introduction of any new method in family planning programme inevitably brings in a new set of variables for the administrator:

- what will be the reaction of the population to this method?
- how should the method be presented to the population? what terminology should be used?
- what types of personnel does it require?
- does its introduction imply a major rethinking of the service structure? For instance, if a male pill becomes available, how does one ensure that it reaches the male population and is used correctly and continuously?

Carefully conducted programme trials of new methods, carried out prior to their introduction in the family planning programme, will help give at least a partial answer to these questions.

This approach also applies to the study of problems that arise with methods already in use in family planning programmes; for instance, a sudden drop in the acceptance rate of a specific method, or an "epidemic" of discontinuation of use. Ongoing WHO studies address themselves to such questions as reasons for discontinuation of use of the IUD in Egypt, or the "pill" in urban clinics in Thailand.

#### (b) Organizational strategies for family planning care

In view of the newness of family planning and of considerable constraints in terms of availability of staff and facilities, research is urgently needed to obtain the best utilization of services, maximize their efficiency, and propose new approaches to the delivery of family planning care. Typical questions that arise are:

- the mix of contraceptives to be provided
- the integration of family planning care with other priority health activities, such as general maternity and child care

- the responsibilities (e.g. for contacting women, or for inserting contraceptive devices, distributing pills, following up patients) and workloads to be given to different categories of manpower (e.g. physician, nurse, auxiliary) in a health service to achieve a given family planning objective. The same activities tasks in different countries may have to be performed by different categories of personnel and in different health service settings
- the value of domiciliary care for family planning
- the most appropriate indices to be used for evaluating family planning activities in health services in different countries.

Some of the WHO-sponsored operational research studies address themselves to several of these issues simultaneously, while others focus on one particular problem. For instance, in a project in a rural area of Thailand, which so far has not been exposed to family planning, the "cafeteria" approach to the provision of method is being examined. National family planning programmes have tended to offer only one method at any one period, and the question remains whether some of the setbacks in these programmes may be due to failure to provide for the varying requirements of the consumers. This WHO study is investigating the factors that affect the selection by the consumer of a specific method, its successful use, and reasons for discontinuation, when several alternative methods are provided on a free, informed and unbiased basis.

Support has been given by WHO to a study in rural India on the provision by auxiliary personnel of family care in various combinations with other health activities; these include services for women and for children. The number of auxiliary health workers was kept constant in four study "cells", each consisting of three or four villages. Preliminary results show a higher level of family planning practice in the villages in which family planning was provided with another health activity. The extent and manner in which traditional birth attendants can participate in family planning care are being reviewed in a study in the Philippines.

Several WHO studies are examining certain obstacles that have been identified in family planning in order to improve approaches and content of related health education and to develop methods to increase consumer participation in the planning and management of services: attitudes of consumers and providers to family planning; community attitudes; communication channels; role of mothers' clubs; acceptance of technological innovations. On the whole, information and education activities have neglected husbands and male methods of birth control, and practically no attempt has been made to inform them about the use of IUDs and pills by their wives. An operational research project in Turkey is giving particular emphasis to this question.

#### 2.4.2. Obstacles encountered and lessons learnt

By the very nature of the complex factors to which these studies address themselves, they need to be carried out in a great variety of settings.

Perhaps even more than in other areas of research, a major difficulty in getting such studies started at the national level, where they must obviously be done by local staff, is the shortage of trained personnel. Several disciplines are needed besides operations research, and a team approach is essential.

A major limiting factor to WHO's efforts in this field has been the absence of staff positions to develop this programme. This is to be deplored since this sensitive area of service research is one in which many governments would welcome WHO assistance, where they are reluctant to accept aid from elsewhere.

#### 2.5. Sterility, foetal development, labour and lactation

##### 2.5.1. Research problems and projects

Sterility is a relatively neglected field, despite the fact that, in some countries, the problem is reported to reach public health proportions. WHO has received requests from several African countries for assistance in determining the extent and causes of sterility with the object of establishing appropriate preventive and curative methods. It has often been claimed that venereal diseases are the major etiological factors, but this assumption does not rest on firm evidence. Protocols are being developed for various approaches to field studies and to the development of the research manpower and facilities required.

The conditions that contribute to perinatal morbidity and mortality vary widely in incidence in different parts of the world, but premature onset of labour is a major factor everywhere, with the highest mortality in the more immature infants. The relative inaccessibility of the human foetus has been a barrier to scientific study. WHO studies in Japan and Switzerland have been evaluating the the impact of environmental hazards on the foetus. A protocol for a WHO-sponsored multi-centred trial is being developed to determine the efficacy and possible dangers of corticosteroids which are presently being widely administered to the mother to induce pulmonary maturation in the foetus, and thus avoid one of the main causes of infant mortality, the respiratory distress syndrome in the newborn.

A considerable effort has also been devoted at a WHO Research Centre in Uruguay to research on labour, in particular to manoeuvres and medications used in the management of normal labour. It has led to recommendations on procedures that are to be avoided, as well as on situations in which active intervention during labour is required. The management of foetal distress in utero has been studied in France and the USSR.

As part of a collaborative study on patterns and trends of breastfeeding and factors influencing them, some research will be conducted on the influence of breastfeeding on the return of ovulation and the effects of hormonal and other contraceptives on the volume and composition of breast milk. The possible transfer of contraceptive steroids or their metabolites to the child will also be investigated.

#### 2.5.2. Obstacles encountered and lessons learnt

In spite of the interest of governments in assistance from WHO on the subject of sterility, this programme is only at its beginning; the level of clinical practice and research is poor on this subject, making it difficult to set up a major international collaborative effort. Moreover, in the countries where the problem of sterility appears to be most acute, the orientation of clinical research workers is primarily towards the rarer endocrinological causes which are presently of interest in more developed countries. It is difficult to find scientists with a community orientation to carry out the demographic, epidemiological and sociological investigations needed to determine the causes of sterility and to think in terms of the preventive services that might be needed.

The situation is somewhat different as regards research in foetal biology, pregnancy and labour. Here not only is there great interest among biologists and clinicians, but also there exists a reservoir of talent that would welcome involvement in international studies. WHO does not, however, have funds either for coordinating or for supporting such studies. Whereas the funds available to WHO for research on fertility regulation have increased very considerably over the past few years to about \$10 million a year, the small amounts for research on foetal biology, pregnancy and labour have actually decreased to below \$100,000.

### 3. CONCLUDING REMARKS

The description given above has indicated how varied can be the approaches to international collaboration in research on human reproduction and family planning. The possibilities of achievement in different areas are subject to different constraints: sometimes, as is the case with sterility, it may be deficient knowledge, in others it may be a shortage of manpower at the international or national level as for operations research on family planning, many areas are hampered by the lack of continuity in funding, in some instances current fashions may virtually exclude an area, such as research on pregnancy, from support at the international level.

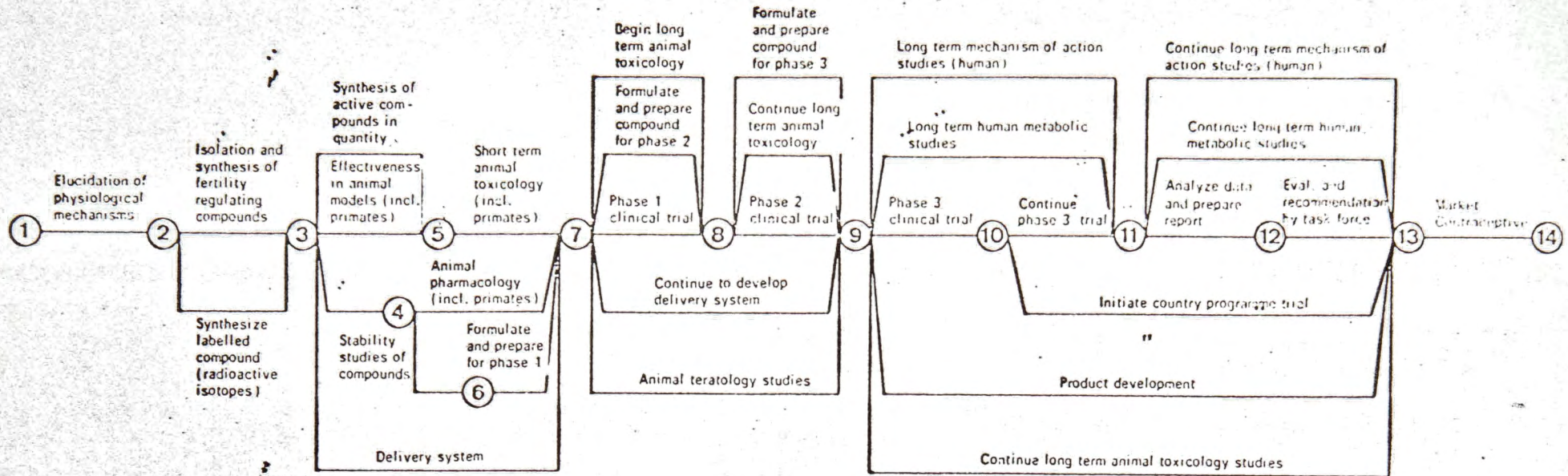
But the common lesson that has been learnt in developing the WHO programme, is that there is a very positive attitude among scientists to international collaborative research, and that by tapping this willingness and talent the scope of research can actually be considerably extended. Care needs, however, to be constantly exerted in order not to

draw scientists , either by the availability of funding or the broader prospects offered by international collaboration, away from research on local and national priorities.

This danger is most easily avoided where some structure for the administration of research exists at the national level to define coherent research policy in this field and to provide mechanisms for the implementation of the research programme. It is surprising how seldom, in developed as well as developing countries, a research policy has been formulated in human reproduction and family planning as well as in other areas of health research. External assistance and training in science policy and research organization in family planning and human reproduction has rarely been offered, or for that matter, requested. It would seem that few assistance agencies wish to spend funds on such activities that have little visibility and no quick returns, and few recipients have insisted on using research funds for this preliminary groundwork. The Organization is attempting to remedy this deficiency by bringing together policy makers and administrators responsible for research in human reproduction and family planning in a series of working groups to define the major issues and strategic approaches.

Figure 1

DEVELOPMENT OF FERTILITY REGULATING METHODS  
MACRO NETWORK  
Chemical Continuous





F. Calogero (Italy)

XXIV-15

Dialogue of Strategic Systems

(Interlocutors: Salviati, Sagredo, Simplicio)

Sal.: A few centuries ago we met to debate an issue that, albeit of a scientific nature, had a major philosophical impact, hence, especially in the long run, a profound influence on world affairs. <sup>(1)</sup> The main difficulty that stood then in the way of agreement was the contrast between those of us who were prepared to abandon long held beliefs on the basis of new evidence <sup>and ideas,</sup> and those who refused to give up the traditional doctrines. It is therefore appropriate that we meet today again, to debate an issue that, although quite different from that discussed in our previous dialogue, might be of comparable importance to world affairs.

Sagr.: You are quite right in pointing out the topicality, and importance, of the debate on strategic systems, although your linkage to our previous debate is rather biased.

Simpl.: Indeed in matters of great political relevance tradition is itself a major element of the equation. For instance, when we defend the Triad, it is not only because of the perfect nature of the number Three, <sup>(2)</sup> and because if in some, however unlikely, contingency, the retaliatory capability of one of its components were to become unreliable, we would still have two systems left, so that if in some, however unlikely, contingency, one more of its components were to become unreliable, we would still be left with one. Actually the argument is considerably more subtle. The fact is that once we have a Triad, our transition to a posture based on anything less than that (for instance, only on Two strategic components, each of which able by itself to inflict unacceptable damage in a retaliatory strike) might be perceived by our adversaries as a sign of weakness, and therefore might mislead them into believing that they could try to evince out of it some political advantage. Pressure, confrontation and crisis

could easily follow from a miscalculation of this nature. <sup>(3)</sup> And there is more to it; for even if our adversaries, who know the facts, might well realize the fallacy and danger of construing any advantage out of such a situation, others who are much less knowledgeable - be they our allies, or in the non-aligned sector - might be misled into interpreting our change of posture as an indicator of weakness; and this might adversely affect our world-wide interests.

Sagr.: This argument has to me a deja vu flavor. Does it not boil down to fear of any novel development, lest it shatters the status quo? Of course, it is a strong argument, as we know from previous experience; <sup>(4)</sup> but it is certainly based on a very myopic perspective.

Sal.: I could not agree with you more. But let me get to the main point. The resources allocated to strategic weapons by the major powers have been growing enormously (or, as some say, obscenely) over the last, say, twenty years; and much more has grown the destructive potential of these weapons. Where is such a divergent process leading us to? How much of a premium should be put on stopping, and indeed reversing, this process?

Simpl.: We are well aware of the dangers implicit in the continual growth of the size and sophistication of strategic arsenals. For this reason we are careful not to initiate developments that might force the other side to accelerate the race; indeed we have given up trying to achieve the capability of a disarming first strike. But as long as the other side is racing - indeed, ahead of us in terms of several strategic parameters - it is only prudent that we keep up. The maintenance of a strategic balance is indeed essential to preserve the equilibrium, on which political détente is based.

Sagr.: But in many strategic indicators it is your side that is ahead, and the other that is trying to catch up. Yet you are now going for an expansion of your strategic forces, that appears directed to a counterforce rôle.

Simpl.: I repeat, we are eager to begin a reduction of the

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Simpl.: I repeat, we are eager to begin a reduction of the

strategic forces by mutual agreement and on terms of parity. That is our first preference. And we would be quite content if both sides avoided the acquisition of major counterforce capabilities. But we are troubled by the momentum of the weapons of the other side, and we simply cannot ignore the prospect of a growing disparity between the two major nuclear powers. We do not propose to let an opponent threaten a major component of our forces without our being able to pose a comparable threat. We do not propose to let an enemy put us in a position where we are left with no more than a capability to hold his cities hostage after the first phase of a nuclear conflict. And certainly we do not propose to see an enemy threaten one or more of our allies with his nuclear capabilities in the expectation that we would lack the flexibility and resolve to strike back at his assets (and those of any country supporting the threat) in such a way as to make his efforts both high in cost and ultimately unsuccessful.

None of this should be taken to mean that exact symmetry must exist between the two offensive forces. Our side is willing to tolerate the existence of asymmetries provided that, in an era of alleged parity, they do not all favor one party. But we are not prepared to accept a situation in which all the visible asymmetries point in one direction.

Sagr.: And what do you mean by "visible"?

Simpl.: This is a good question. The point is of course that unless it is unambiguously clear that no imbalance or trend is in the cards which might be interpreted as favoring the adversary - unless this is crystal clear to friends and foes - prudence requires that we take appropriate measures to restore that confidence which is after all the fundamental guarantor of peace and of détente.

Sal.: But if the other side takes a similar stand, is this not the recipe for indefinite continuation of the strategic arms race? And let me ask once more, where is this going to lead us to, in the long run?

Simpl.: In the long run, you know, we shall all be dead.

Sagr.: This is a good joke, but surely an irresponsible stand for a decision maker (and also for a strategic analyst). For instance.

how do you envisage coping with nuclear proliferation? Do you think you can stop the process in an environment in which the strategic arms race between the Superpowers goes on unabated? Or you have given up worrying about it?

Simpl.: The prevention of nuclear weapons proliferation stands very high on our list of priorities. Have we not signed and ratified the Non Proliferation Treaty, and indeed tried to convince all other countries to accede to it?

Sagr.: And what about the prevention of the so called "vertical" proliferation, namely the strategic arms race between the Superpowers, that was supposed to be a sort of quid pro quo in exchange for the renunciation by other countries to go militarily nuclear? After the NPT, we have witnessed and are witnessing substantial technological and numerical expansions in the strategic weapons of the nuclear weapons powers, and especially the Superpowers, USA and USSR; not to mention the slap in the face represented by the last agreement on underground nuclear testing, which is really something like a bad joke.

Simpl.: We are continuing to negotiate in SALT, and, as I indicated above, our position is a reasonable, peace-loving, one; it is the other side that insists in trying to get, or retain, some advantages, at least in some sectors.

Sal.: All you have said up to now - and moreover, an objective analysis of the developments over the last years - implies that it is unlikely that any substantial SALT agreement will be achieved, unless something drastic occurs (a major nuclear accident? a major socioeconomic crisis?). Short of that, I continue to believe that the only (faint) hope for a significant disarmament agreement (i. e., one resulting eventually in substantial weapon reductions) lies in a change of focus in the SALT negotiations to escape the parity argument, which gets eventually interpreted so that each side cannot afford to be inferior in terms of any strategic indicator - an argument that, even if overruled in the negotiating process, pops up again (and no less damagingly) in the ensuing debate within the decision making system of each Superpower.

Indeed such arguments could be largely bypassed by structuring the agreement in terms of a procedure; namely, rather than trying (unsuccessfully) to agree on what to reduce, to negotiate instead the rules of a disarmament scheme which might be easily devised so as to imply over the years substantial weapon reductions, providing throughout the process maximal security to every party. The procedural rules could be symmetrical, although they would result in unsymmetrical - but balanced - reductions, corresponding to the objective lack of symmetry that characterizes the real world; thus, the hawkish criticism charging the negotiators with sell-out and gullible acceptance of unfair terms should be somewhat muted. Moreover, such a procedure would decouple the internal debate within the decision making system of each Superpower over what to reduce from the decision to accept the onset of the disarmament scheme, a decision that could therefore be taken more on the basis of general principles and longer range perspectives, with much less scope for bureaucratic attrition.

To illustrate what I have in mind it is perhaps appropriate to recall the "archeological" example. "When an archeological expedition undertakes a campaign of excavations in a foreign country, it must of course ask permission from the government of that country. Many countries grant such permission under the provision that only a certain fraction, say, one-half, of the material (statues, vases, etc.) discovered be exported; the rest is to be left behind and displayed in host museums. Therefore at the end of the excavations, the archeologists and officials of the host country must meet to divide the total bounty into two parts.

Clearly, should a negotiation start with this provision, it would most likely end in a stalemate, in view of the great difficulty in assessing the value of the different items. This would happen even if both parties started with the best of intentions to agree on a fair division according to the accepted 50-50 rule. But a very simple trick succeeds in completely bypassing the controversy over the comparative value of each item: the archeologists divide all the material into two equal lots, exercising their own judgement, and the officials of the host country subsequently choose one of the two lots.

This example points to the possibility of inventing a procedure to achieve a goal desired by two parties which avoids the controversy that

would almost certainly erupt if its implementation were instead attempted by direct negotiation.

The problem of limiting the strategic arms race between the superpowers is analogous if we believe that the chief decision-makers in the United States and in the Soviet Union do wish to achieve this aim, but find its attainment extremely hard due to the difficulties inherent in the negotiating process." (5) Indeed, the adaptation of such an approach to disarmament is not difficult, although non trivial; its practicality has been discussed in some detail elsewhere. (5)

Of course, disarmament proposals that take an across-the-board approach - such as overall budget limitations (which do, however, raise difficult problems of their own) - also partake of the same general philosophy.

Sagr.: You may be right. But you know, that's just not the way international treaties are made.

Sal.: Well, I wonder. But let me return to the central issue. Since time immemorial it was prudent for a man, or a nation, to be as well equipped as possible to counter any conceivable threat. In international affairs, to be well prepared for war was the recommended policy to maintain peace ("si vis pacem, para bellum"). In this context, having more strategic options at one's disposal could only be considered desirable. Such a concept is therefore deeply engrained in the psychology of the public at large, and of the politicians and decision makers who are their leaders. To be sure, there is now some realization that, in some cases, having more options at one's disposal may force others to strive for the acquisition of similar options, the end result being a net loss for almost all the parties involved (the exception being represented by those groups whose interests, economic or bureaucratic, are vested in the continuation and expansion of the arms race). Indeed, as we just heard, a lot of lip service is paid to such concepts; moreover, it was just the emergence of such an understanding that brought into being the ABM Treaty. Yet concepts that have a millennial historic background are slow to change, much too slow as compared to the increasingly rapid pace of technological development. This is, it seems to me, the fundamental problem that we face, and the origin of

our frustrations; it takes much too long to remove obsolescent conceptions; and especially so, when clever analysts try to recast them in sophisticated terms ("flexibility"), sounding much like the Ptolomeists of Galileo's time, with their eccentrics and epicycles....<sup>(6)</sup>

Sagr.: What you are saying is probably correct, and yet rather useless, since it has little, if any, normative content.

Sal.: True; but ideas are important; and so is intellectual honesty. Thus let us at least try to expose the fallacies where we believe we spot them; and insist in raising basic questions, even if they sound unsophisticated. The main one is: where are we heading for in the long run, that is, over the next few decades?

#### NOTES

<sup>(1)</sup> G. Galileo, Dialogo dei Massimi Sistemi (Dialogue of the Great World Systems), 1632. The main scientific issue debated in this book (the major work by Galileo) is the comparison between the Ptolemaic (Earth-centered) and the Copernican (Sun-centered) systems.

<sup>(2)</sup> Simpl.: "...Non avete, primieramente, che oltre alle tre dimensioni non ve n'è altra, perchè il tre è ogni cosa, e'l tre è per tutte le bande? e ciò non vien egli confermato con l' autorità e dottrina de' i Pittagorici, che dicono che tutte le cose son determinate da tre, principio, mezo e fine, che è il numero del tutto? E dove lasciate voi l' altra ragione, cioè che, quasi per legge naturale, cotal numero si usa ne' sacrifici degli Dei? e che, dettante pur così la natura, alle cose che son tre, e non a meno, attribuiscono il titolo di tutte? perchè di due si dice amendue, e non si dice tutte; ma di tre, si bene...", ibidem. ("Don't you have primarily that, besides the three dimensions there is none other, because the three is all, and everywhere? and is this not confirmed with the authority and doctrine of the Pythagoreans, who say that all things are determined by three, beginning, middle and end, that is the number of everything? And where do you place the other argument, namely that almost by natural law, such number is used in the sacrifices of the Gods? and that, by



nature, of three things, and not of less, it is said all? because of two it is said both and not all; but of three, you do...").

(3) This sentence, as well as several others in the following, are verbatim quotes from a recent official document written by a major strategic analyst and decision maker (easily recognizable by the experts). These quotes have not been identified as it would be unfair to associate these points of view with the one side that is more candid in expounding them. Indeed, judging from the decisions on weapons developments and deployments, such points of view must carry great weight within the decision making systems of both Superpowers.

(4) "Dico che mi pare che V. P. et il signor Galileo facciano prudentemente a contentarsi di parlare ex suppositione e non assolutamente, come io ho sempre creduto che habbia parlato il Copernico. Perchè il dire che, supposto che la terra si muova e il sole stia fermo, si salvano tutte l' apparenze meglio che con porre gli eccentrici et epicycli, è benissimo detto, e non ha pericolo nessuno; e questo basta al mat matico: ma volere affermare che realmente il sole stia nel centro del mondo e solo si rivolti in sé stesso senza correre dall' oriente in occidente, e che la terra stia nel 3° cielo e giri con somma velocità intorno al sole, è cosa molto pericolosa non solo d' irritare tutti i filosofi e theologhi scholastici, ma anco di nuocere alla Santa Fede con rendere false le Scritture Sante;...".  
("I say that you and mister Galileo would be well advised to speak hypothetically and not absolutely, as I always thought Copernico did. Because to say that, assuming the Earth moves and the Sun stands, one can reconcile all evidence better than by introducing the eccentrics and epicycles, is well put, and involves no danger; and this suffices to the mathematician; but to actually say that the sun is at the center of the world and only revolves unto itself without running from Orient to Occident, and that the Earth is in the third heaven and rotates with extreme velocity around the Sun, this is something that stands in great danger not only to irritate all scholastic philosophers and theologians, but also to damage the Holy Faith by proving the

Holy Scriptures to be wrong;..."). From a letter by cardinal Roberto Bellarmino to the Carmelitan monk P. A. Foscarini, in Opere di Galileo Galilei, XII, pp. 171-172.

(<sup>5</sup>) F. Calogero, Proceedings of the Twenty-Second Pugwash Conference on Science and World Affairs (Oxford, England, 1972), pp. 305-317. A slightly revised version of this paper (from which the sentence quoted here has been taken) has been published in Science and Public Affairs (Bulletin of the Atomic Scientists) 29, 16-22 (1973).

(<sup>6</sup>) At the time of Galileo the Ptolemaic, Earth-centered, theory had reached an extreme degree of sophistication, to accomodate the large body of detailed astronomical data. Indeed, according to some science historians, these sophisticated refinements allowed this theory to fit the experimental evidence then available even better than the Copernican, Sun-centered, model did; although of course the basic conception was totally wrong. Is this a lesson?

POWER TO IMAGINATION

In Paris in '68, one could read on the walls: "L'imagination au pouvoir" (power to imagination). The idea that some entirely new approach has to be found, so that a problem apparently impossible to solve can be treated, seems relevant to the intricate political situation in the Near East. It is very difficult to imagine that knots can be untied if one goes on quoting sacramental sentences from the past: rights can always be opposed to other rights; it is a fact that no boundary exists that has not been the result of a balance of forces and a compromise. One can say that no boundary exists that has been considered the best solution by any of the countries involved. If one does not wish a new war to occur, one must look for the combination of two less than ideal but acceptable solutions.

On examining, for instance, the history of the boundaries between France and Germany, obviously one can say that Alsace was a German country before the seventeenth century and that it was practically a German country just before the First World War, but that it was French from the seventeenth century to 1870 and from 1918 to the present. Today, it is French again, but many people living there work in Germany; indeed, the European Economic Community, which was the hope of very few dreamers fifty years ago, now makes the entire problem obsolete. When one reads what the French and German jingoists wrote before or immediately after the First World War, it is obvious why two wars have occurred; everyone had solid historical reasons to feel self-righteous: something entirely new had to be found to make a solution possible.

When one looks at the situation in the Near East and when one listens to the people involved, it is difficult not to think that the last one to speak is always right, and he probably is; but the problem is not to be right or wrong, it is to be able to forget one's own point of view long enough to understand the other's -- to know that whatever has occurred in the past, people in that unhappy part of the world will have to live together, will have to do things together, will have to mix and try to become, if not one united people, at least complementary elements of a region at peace. To achieve this state will be the job of many years. There is no time to lose.

DIFFERENT APPROACHES TO INTERNATIONAL COOPERATION IN  
SCIENCE AND TECHNOLOGY WITH SPECIAL REFERENCE TO  
ATOMIC ENERGY

The utilization of nuclear technology by the developing countries varies in intensity from those which have nuclear power programmes and nuclear research centres on the one hand, while at the other end of the spectrum are those looking for water for village settlements in the rural development of tropical Africa. The question of the transfer of this technology is a problem of special importance, therefore, for the developing countries. Their needs range from the creation of local skills and expertise and the acquisition of techniques, to the financing of nuclear projects requiring, in certain cases, large amounts of capital. Nuclear and conventional technologies are interdependent and have to be related to specific conditions prevailing in different developing countries. The introduction of this particular technology in a developing country depends to a large extent on the state of its scientific and technological infrastructure. A substantial effort has, therefore, to be made to develop the infrastructure to the point where the assimilation of nuclear technology becomes relatively easy.

In general, the type and scope of assistance provided by the Agency depends on technical and scientific, as well as specific nuclear development in the requesting countries. A description of the type of assistance most frequently requested by various countries of the same category, from the point of view of their degree of development, may be a useful illustration of the methods utilized in transferring nuclear technology.

Countries can be divided into four categories between which, however, there are no rigid dividing lines:

- (i) Countries that are taking the first steps towards technical, scientific as well as nuclear development. Approximately 20 per cent of the total membership belong to this category;
- (ii) Countries that have made some progress in introducing nuclear science and the application of radioisotopes in agriculture and medicine, etc. Approximately 30 per cent of the total membership belong to this category;
- (iii) Countries which have established, or have planned to establish in the near future, research reactors or sub-critical assemblies, or both, and already utilize the application of radioisotopes. Approximately 30 per cent of the total membership belong to this category; and
- (iv) Countries that have nuclear reactors for power production either in operation, under construction or in an advanced stage of planning, or are undertaking the improvement of industrial processes, and devoting substantial funds for research and development. Within this category it is estimated that there are some 15 developing countries with active nuclear programmes.

The availability of trained personnel is of course of prime importance at all stages of development corresponding to the categories described above, and is a pre-condition for passing from one stage to another. The needs in training, as indeed the needs in other types of assistance, will vary, however, from category to category.

First category. Scientific and technical education is a predominant requirement for this group of countries. The establishment of a nucleus of scientists and technicians capable of laying the foundations for the development of various peaceful uses of atomic energy is

the main problem. The prime importance of creating facilities for the teaching of atomic energy sciences at institutes of higher education has become evident over the years. In the United Nations family, close cooperation with UNESCO is maintained and panels composed of representatives of the developing countries, UNESCO and the Agency have provided advice on the curriculum in these institutes of higher education. Specifically, when developing countries require assistance which involves a direct and close link with the development of atomic energy, such as, for instance, in nuclear physics or radiochemistry, the Agency sends visiting professors.

Fellowships, especially for the training of future higher education instructors, and the provision of scientific equipment, have a complementary role. Countries in the first category sometimes seek assistance in the application of radioisotopes in medical and agricultural work; such projects are usually carried out in scientific facilities with a small staff and a modest amount of equipment.

Second category. Countries of this group include those which have made some progress in nuclear science and already have research institutions. Their needs are often characterized by a relationship to economic aspects, such as an increase of crop yields by proper use of fertilizers and, in some cases, development of new plant strains by induced mutations. The application of radioisotopes is mostly used as a new tool to assist them in scientific and technical work which has already been undertaken by conventional means. Since over 25 per cent of the Agency's assistance to developing countries consists of aid in the agricultural sector, this reflects the value

of nuclear technology in specific cases, such as the more economical use of fertilizers which can only be studied by nuclear techniques. Considerable savings have already been made in developing countries as a result of assistance in this field. Similarly, the introduction of high yielding strains of seeds has led to increased yields. It is also common for this group to utilize nuclear techniques in medicine, particularly in relation to diagnosis and therapy of diseases endemic in those countries. The introduction of a radio-diagnostic service in hospitals and the uses of radiotherapy are common features in programmes of the last ten years. When the services and facilities are established, any further assistance from the United Nations family is a matter for the World Health Organization. A further form of aid commonly requested by this group is in the prospecting for, and development of, their nuclear mineral resources, either for their value as an export commodity or as a provision for the anticipated future needs of the country in nuclear materials. Initially, this prospecting was usually carried out as part of an overall mineral resources survey of the country but in recent years, due to the need for uranium on a world-wide scale, individual nuclear mineral surveys are being undertaken and large-scale project assistance up to the actual development of economic resources, i.e. pre-investment stage, has and is being carried out. In this group also, utilization of nuclear techniques as an additional tool in water supply and irrigation projects in which tritium tracer methods are applied, has been a significant feature. Conventional hydrological services are being advised on the role of tracers in their hydrologic studies. This group of countries, since it has made a start in the use of nuclear technology in economic and scientific development,

tends to look to the long-term planning of nuclear technology in development, and the Agency assists countries by the use of atomic energy planners, who are senior scientists and engineers, with the task of assessing the situation in the country, identifying those programmes which may benefit from an application of nuclear techniques, and also giving advice on organizational and administrative infrastructure required to assimilate nuclear technology.

The training needs from the second category of countries emphasize the training of specialists in various techniques in the application of radioisotopes, especially in agriculture, hydrology and medicine. The Agency also sponsors training courses in the application of isotopes which are of particular benefit to this group. Assistance is also given in fundamental nuclear education with emphasis veering gradually from visiting professors to fellowships for post-graduate studies.

Third category. This category consists of countries that have established, or plan to establish in the near future, research reactors, sub-critical assemblies, or both. They usually have a comprehensive range of scientific institutions and possess the main element of technical knowledge necessary to enable them to obtain full benefits of nuclear technology. These conditions are not only desirable for the application of radioisotopes but are necessary for the operation of a nuclear research reactor and the ancillary laboratory facilities. Such facilities are most effectively operated in places where there is ready access to essential technical services, spare parts and supplies. This category of countries makes possibly the greatest volume of demand



for assistance. Research reactors were provided to nearly 30 developing countries under bilateral auspices and with the withdrawal of financial and other support by the donor country, the Agency had to assume considerable responsibilities for which resources were lacking. The nature of the assistance provided is often similar to that received from countries in the second group but, in addition, greater emphasis is laid on health physics and radiological protection, metallurgical research, fuel elements fabrication, nuclear electronics and instrumentation, as well as on reactor construction, safety evaluation and research programming. There are many examples of Agency assistance in highly specialized applications of radioisotopes in industry, biology, entomology and nuclear irradiation. Fuel fabrication, processing of uranium ores and production of uranium metal are also on occasion carried out by this group of countries.

The training needs are exemplified by the training of reactor physicists and engineers, specialists in nuclear waste management, health physicists and specialists in isotope applications, particularly in industry.

Fourth category. Developing countries in this category have initially arranged for assistance through bilateral channels, but the Agency's aid is usually in connexion with more specialized activities, such as the evaluation of reactor hazards, fuel reprocessing and special metallurgical problems. Surveys of economic feasibility of nuclear power; site and hazard evaluation; health, safety and waste management; missions composed of 3 or 4 members, are features of the aid to this group of countries.

Several developing countries have nuclear power stations in operation or under construction. Many others, foreseeing the shortage of conventional power sources in the next two decades, have carried out or are carrying out feasibility studies. The whole process of the introduction of nuclear power requires the state concerned to start planning at least 8 to 10 years before a nuclear plant is to go into operation. In preparation for this work, the Agency's programme is being increasingly utilized by developing countries for the essential training of personnel. An expanded training programme for nuclear power is shortly to be undertaken consisting of a specialized long-term course for scientists and engineers, to be repeated annually for a five year period. At the same time, two or three more specialized courses of short duration will be held annually.

In the light of the energy situation, the Agency, in 1972, initiated a nuclear power market survey involving the analysis of the future power requirements of <sup>developing</sup> 14/countries, as a basis for determining the overall requirements for all developing countries. The success of this survey has led further developing countries to request a survey of the potential of nuclear power in their country and the survey is being expanded.

It is possible to identify four stages with regard to the introduction of nuclear power. The first is a preliminary survey by the Government. The second is a preliminary study which could require a total of 1 or 2 man years of effort by experts. Technical assistance is utilized at that stage, particularly to show if the time scale is realistic. The third stage is a feasibility study, which is normally carried out by a firm of consultant engineers, and followed by the preparation of tenders and the provision of assistance

in evaluation of the bids received. For this stage, the Agency's technical assistance programme is utilized, especially in helping the government to choose a suitable consultant engineering firm. At the fourth stage, assistance is provided in supervising the construction work and in the eventual commissioning of the power reactor, which is normally carried out by one of the consultant engineering firms.

TOWARDS NUCLEAR DISARMAMENT :  
NEED OF A GRAND DESIGN WITH A TIME SCHEDULE

It has been nineteen years since the Russell-Einstein Manifesto was issued. There it was stated that an agreement to renounce nuclear weapons as part of a general reduction of armaments would serve certain important purposes, although it would not afford an ultimate solution. The manifesto also pointed out that, whatever agreements not to use H-bombs might be reached in time of peace, they would no longer be considered binding in time of war.

The keynote of the Russell-Einstein Manifesto was elaborated in the Vienna Declaration issued by the Third Pugwash Conference, held in Kitzbühel and Vienna, 1958. This declaration stressed the necessity, first of all, for the elimination of all wars, and, secondly, stated in detail the necessary conditions for terminating the arms race. One year later, the 14th UN General Assembly adopted unanimously the 82 Country Resolution with Respect to General and Complete Disarmament, wherein two declarations, one by the UK on the 17th of September, 1959, the other by the USSR on the 18th of the same month, were mentioned.

As far as nuclear disarmament is concerned, no appreciable progress has been made since then. On the contrary, the nuclear arms race between the USA and the USSR has been escalated spirally and the proliferation of nuclear countries has not ceased. In the meantime, the confidence in the so-called nuclear stalemate, due to the highly developed nuclear weapons systems in both the USA and the USSR, has infiltrated even the minds of intellectuals in the nuclear countries. Hence, people, particularly the younger generation, seem to have lost interest in the problem of nuclear disarmament.

Indeed, the Pugwash Conferences have constantly pressed for the solution of nuclear problems and several proposals have been seriously discussed at them. However, it is also true that we have not yet acquired any bright prospect of even slowing down the nuclear arms race, although several efforts to avoid nuclear catastrophes have been made between the USA and the USSR (e.g., the hot line, SALT-I, and the agreement to prevent nuclear war). There may be different interpretations of these slight advances and different opinions of how to proceed from here. For instance, some may hold that until a certain structure of the world will be established, in which war will be made extinct, we shall not be able to expect any disarmament. In any case, it is of primary importance

for us to make efforts to eliminate the causes of war in so far as possible. Furthermore, it appears rather difficult to separate nuclear armaments and modern non-nuclear armaments in questions of maintaining a balance. Some consider that we should therefore seek general disarmament. We do not deny that these statements have some basis. Nevertheless, we are convinced that the nuclear arms race and nuclear proliferation, because of the self-driving mechanism that governs their development, should not be neglected while we seek such more general solutions.

Since the first two nuclear bombs were dropped successively on Hiroshima and Nagasaki in 1945, nuclear weapons have so far not again been triggered, but they have been used several times for explicit political purposes. It is needless to say that the extensive development of nuclear weapons systems has given rise to an enormous danger in case the so-called nuclear deterrence fails. At the same time, the feasibility of making small-size nuclear weapons has been increasing considerably, due to the spread of nuclear power plants in many countries. In addition, the still-prevailing legend of nuclear deterrence is likely to intensify the desire for nuclear weapons of the countries who do not yet possess them. The world forgets too easily that nuclear war can happen, but must not be allowed to occur.

Under these circumstances, we think it is worthwhile to concentrate our efforts to search out definite ways towards nuclear disarmament by means of intensive collaboration among the world's scientists. In fact, we have accumulated a great deal of proposals, comments and discussions with regard to nuclear disarmament from the past Pugwash Conferences. Therefore, if we remind ourselves of the fourth paragraph of the Russell-Einstein Manifesto we might be able to reach a meaningful result. This paragraph reads as follows: "We shall try to say no single word which should appeal to one group rather than to another. All, equally, are in peril, and, if the peril is understood, there is hope that we may collectively avert it."

Of course, while we realize the complexity of the problem, we believe that Pugwashites have to face this difficult task. We Japanese Pugwashites are planning to hold a Pugwash Symposium at Kyoto from the end of August to the beginning of September 1975, focusing on nuclear disarmament. The first Pugwash Conference was the first attempt of the scientists of the world to talk together about the problems of peace since the Second World War; similarly, the coming symposium to be held in Japan will be the first such undertaking of Japanese Pugwashites. Hence, we would like to adhere to the size and style of the first Pugwash Conference as much as possible. We are looking forward to making a new grand design and a time schedule towards nuclear disarmament.

In the following, we outline briefly our tentative programme. First, we shall try to derive a few fundamental principles with regard to nuclear disarmament from the past disarmament talks and discussions, especially from the records of the Pugwash Conferences. These principles must be acceptable to every nation, so that they may be building stones for our edifice of peace. Secondly, we shall classify common understandings of the nature of nuclear weapon systems. This work will not be easy, because the nuclear policy of each country has been strongly affected by its own historical and social background. However, in order to reach a definite agreement in a limited time, it seems quite important to collect the common understandings as much as possible.

We urge our colleagues to join this undertaking and to exert their intellectual abilities in close collaboration with members of the younger generation.

A NEW NEGOTIATING BASIS FOR FUTURE STRATEGIC ARMS  
LIMITATION TALKS

I. Introduction

Predicting that it would be very difficult to arrest the deployment of MIRVs at the SALT II negotiations, J.P. Ruina writes in his article "SALT in a MAD world" "... even limiting them (the MIRVs) would be difficult, for there are so many ways to measure equality -- the total number of warheads, the total number of missiles, the total number of missiles that have multiple warheads, the total explosive power of missile payloads ...". He goes on in the same article to point out that the inability to agree on which physical parameter of a missile force should be used as a common measure of strength will probably lead to an impasse. A few days later, H. Kissinger confirmed this prediction by singling out the same absence of a common denominator of nuclear strength as the reason for the failure of SALT II to achieve substantive arms limitations; he is quoted in the New York Times of 5 July 1974 as stating that "the key obstacle to a breakthrough ... was the difficulty of agreeing upon how to balance missile totals and warhead totals."

Warhead yield, re-entry vehicle accuracy, number of re-entry vehicles per missile, number and size of missiles, all are parameters with which one can measure one or another performance characteristic of a missile force. As long as there is no agreement between the participants at SALT which of these variables or combination of variables must be used as a yardstick to decide equality between the two arsenals, all future efforts at controlling strategic weapons appear doomed ab initio. The present disagreement stems from the built-in differences in the two arsenals: the US arsenal contains fewer and smaller missiles than the Soviet strategic force, but more re-entry vehicles with better performance characteristics. The Soviet arsenal has larger missiles and larger warheads but lags behind the US missile force in technological sophistication. Thus, each country is interested in controlling the further increase of a different variable, thereby generating the impasse.

This paper proposes a new parameter of missile performance as a measure of equality that essentially integrates all the above variables into one quantity. This parameter appears to have two major advantages over any other variable that

describes missile performance.

- i. It incorporates all the relevant variables that describe the counter-force or counter-value performance capabilities of a nuclear arsenal into a single number.
- ii. Therefore it provides a straightforward method
  - a. to compare quantitatively the total destructive capacities of the two missile forces
  - b. to calculate the level of damage which the missile force of one nation can inflict upon the missile silos of the other.

Section two of this paper presents and analyses briefly the mathematical derivation of this parameter and offers an illustrative example of its use. The last section, again briefly, raises and attempts to answer some questions related to the use of this parameter as a negotiating basis in future Strategic Arms Limitation Talks.

## II. The proposal

As has been shown previously, the probability that  $n$  warheads, each of yield  $Y$  (in megatons), delivered with an accuracy expressed by a CEP (in nautical miles), will destroy a missile silo hardened to withstand overpressure  $H$  (in psi), is: \*

$$P_k(n) = 1 - \exp\left(-\frac{K \cdot n}{2H^{\frac{2}{3}} [f(H)]^{\frac{2}{3}}}\right)$$

where

$$K = \frac{Y^{\frac{2}{3}}}{(CEP)^2}$$

The product  $K \cdot n$  describes completely the performance of a missile since it incorporates the number of re-entry vehicles  $n$ , their accuracy (CEP), and the yield of each of the warheads they carry.

Therefore  $K \cdot n$  describes completely the cumulative lethality carried by a missile against a silo. The product, then, of the  $K \cdot n$  of an individual missile times the number of such missiles  $M$  in a nuclear arsenal of a nation, is a quantitative measure of the ability of this nation to inflict damage upon an opponent's missile silos or other civilian or military installations.

The parameter  $K$  has another useful property. As has been shown previously,  $K$  can also be used to calculate the lethality needed to destroy a silo of given hardness,  $H$ , with given probability,  $P_k$ , since:

$$K = 2H^{\frac{2}{3}} [f(H)]^{\frac{2}{3}} \left| \ln(1-P_k) \right|$$

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\*  $[f(H)]^{\frac{2}{3}}$  is a correction factor of order .1



Therefore, if a nation possesses the number  $S$  of silos each requiring lethality  $K$  to be destroyed with a given probability  $P_k$ , the total amount of lethality that an adversary's missiles must carry to achieve that task would be  $K \cdot S$ .

By simply comparing the value of  $K \cdot n \cdot M = K \cdot N$ , where  $N$  is the total number of re-entry vehicles in the arsenal of one country, with the value  $K \cdot S$  of the second, one can decide whether the strategic forces of the former threaten the survivability of the land-based strategic missiles of the latter. By calculating the  $K \cdot N$  value of the missiles of each country one can compare quantitatively the strengths of the two arsenals.

It is recognized that arms-limitation agreements are essentially political in character. Thus it may be thought that a highly technical, and somewhat mechanistic approach, such as the one proposed here, would not really be a very useful approach. This proposal suggests that the use of the  $K \cdot N$  and  $K \cdot S$  values as a negotiating base is not artificial and mechanistic since it provides a common realistic negotiating ground that permits the political considerations to play their important role.

It is proposed then that the US and the Soviet Union use  $K \cdot N$  as an agreed upon measure of the strengths of their national strategic missile forces. Then a negotiated agreement on a common  $K \cdot N$  value for both countries will ensure equality of performance of the two strategic forces, independently of the precise composition of each force. For example, if it were agreed that each country will be allowed  $K \cdot N = 20,000$ , one nation may decide to reach this aggregate by deploying one thousand missiles each with two re-entry vehicles of  $K=10$ , and the other by having 500 missiles each with five re-entry vehicles of  $K=8$ . Thus, once overall equality of performance is established by agreement, the detailed complexion of each arsenal is decided internally in each country independently of the other.

It is further proposed that in order to guarantee the survivability of the land-based missile forces of both countries the same analytical method is used to extend the agreement to the number and hardening of silos. This can be accomplished by specifying that the  $K \cdot S$  value for each country be fixed, that it be equal in the two countries, and that  $K \cdot S$  be several times larger than  $K \cdot N$ . Under this last stipulation, the survivability of at least a large portion of the silos in each country is guaranteed with mathematical certainty. Once again, equality of the  $K \cdot S$  values in the two countries leaves the combination of hardness and number of silos, that add up to this value, to internal choices in each country.

### III. Corrolaries to the proposal

It is suggested in this section that the proposed basis for negotiations at SALT is politically and diplomatically feasible, and, furthermore, that any agreements based on it are verifiable by national means. The highly technical character of the ABM treaty has established a diplomatic precedent for the inclusion of technical terms, such as the product of K and N, in international arms control agreements. The extensive internal flexibility that a nuclear weapons limitation based on K·N values affords the participants suggests that such an arrangement would be politically acceptable. An agreement based on K·N and K·S values permits a wide spectrum of strategic and technical options. Furthermore, by safeguarding the future invulnerability of land-based missiles, it could elicit the support of the US Air Force and the Soviet Strategic Rocket Forces.

An agreement based on K·N values is readily verifiable by national means of inspection. The number and hardness of silos is readily observable. The accuracy and number of warheads on a MIRVed missile can be verified unilaterally by monitoring the testing activities of each country. Finally, the yield of available warheads is either known from past tests or can be calculated by monitoring the underground testing of new nuclear devices. If the aggregate K·N loading of the missile force of one country is agreed to be much smaller than the total K·S of the silos of the other, then small departures from the agreed missile K·N value will not be significant, thereby obviating the need for a very high level of confidence in verification. Such an agreement appears to be stable with respect to suspected violations. If one participant decides to violate the agreement, either overtly or covertly, the effort necessary to overcome the gap between the K·N loading of his missiles and the K·S needed to destroy the silos of his opponent will be so intense and so protracted that it will be detected. The other participant can then react in time, thereby redressing the balance and thus making any decision to depart from the agreement a priori unprofitable.

CONCERNING INTERNATIONAL SCIENTIFIC COLLABORATION

IN THE FIELD OF BIOLOGY

The policy of peaceful co-existence between the two social and political systems on our planet is favourable to the development of international scientific collaboration today. This policy was consolidated further after the recent meeting between the First Secretary of the Communist Party of the Soviet Union, L. I. Brezhnev, and the President of the U.S.A., R. M. Nixon. The approach to the problems discussed at this meeting showed the prospects for the development of cultural and scientific collaboration not only between the Soviet Union and the U.S.A., but also among all countries. The advanced preparations for the forthcoming European Conference are also an important factor creating conditions for the development of cultural and scientific collaboration among different countries.

As a result of the present favourable international situation, of the warm breeze in international relations, the problems of international scientific collaboration appear in a new light. There are more favourable possibilities for using science, this powerful and creative force, for peaceful purposes: for the welfare of mankind, for improvement of the standard of life, for the prosperity of culture. In this respect, the great importance of collaboration in the field of biology should be pointed out, since biology is the science of life, of nature in its diversity, of its creation, development and utilization. One of the most important aspects of this collaboration is the selection of biological problems which should be given the greatest emphasis through the united efforts of scientists from the different countries of the world. The problems which receive special attention should be those in which most countries are interested and those problems whose solution would represent the greatest advantage to the most people.

Of course, the problems of biological science on which the army of thousands of scientists is working are numerous. When one reviews the subjects being studied in the different academies, universities and scientific institutes in the field of biology, one finds that the same subjects, the same problems, are studied in many countries. An attempt at systematizing some of the problems on which international collaboration is imperative yields the following order:

1. Problems of life related to the origin, movement and development of living organisms in ontogenesis and philogenesis. Here are many problems related to molecular biology, to the part played by nucleic acids in transferring hereditary information, to photo-synthesis, to synthesis of artificial albumen, to biogenic stimulants, to longevity of man, etc. The problems of industrial micro-biology and especially of the importance of the enzyme systems and micro-organisms as factors for albumen synthesis, i. e. of the transformation of micro-organisms from enemies to friends of men, are particularly current. Therefore, international scientific collaboration in this field should be improved by establishing international institutes and laboratories to assist the solution of these problems. There are great prospects for industrial microbiology, genetics, enzymatology, bio-chemistry and other branches of biology.

2. The next pressing problem is related to man and his environment. This topical problem has been a favourite subject of many congresses, conferences and symposia during the past 2 or 3 years. As is well known, it is related to the scientific study of methods and means for the protection of nature, air, water, the biosphere, and in general, of the conditions in which man is born, lives and works. Technical progress and intensive industrialization, particularly in some regions of Europe and the U.S.A., have a negative influence on the environment. This fact requires the continuation of international collaboration among scientists working on this problem, but in a more specific way. Independent solutions of the problems related to man and his environment in the small countries and local measures taken cannot alone have positive results.

3. The third important biological problem requiring a coordination of the efforts of all scientists relates to fighting some of the diseases of men, animals and plants. These are cancer, cardiovascular diseases, the use of drugs and alcoholism. They represent real disasters for modern society. As is known, a great number of national scientific institutes exist. Collaboration on cancer problems was one of the items in the last agreement signed between the USSR and the USA. However, the misfortune of cancer is so great that all efforts should be coordinated on a world scale. A world institute to deal with cancer studies should be founded. Future generations will be grateful if such an institute is established and if successful methods for preventing and limiting this disease are found.

Some epizootics of virus etiology such as foot-and-mouth disease of cloven-hoofed animals which appear periodically in some countries are very dangerous and can provoke economic crises. A world institute should also be established with a view to fighting this disease.

One of the essential problems related to the production of food is the fight against some diseases and pests of plants, such as the harvest bug, widespread in some African,

Asian and even European countries. It is necessary to fight against some pests, such as grasshoppers and caterpillars, which devastate large regions of some countries. New efficient biological methods should be found to exterminate these pests, and they can be developed through establishing close economic collaboration.

4. Another urgent problem requiring vast international scientific collaboration is the scientific location of new sources of food for the population of our planet. The forecast is that the population will reach 6 billions by the year 2000. Therefore the provision of food, and especially proteins, should be doubled through the use of biological sources. The oceans, rivers, plants and animals are the primary biological source. Industrial micro-biology is the second source, and the third is chemical synthesis. Consequently, close international collaboration is necessary in this respect.

There are many other biological problems, connected particularly with medicine and agriculture, which require international scientific collaboration on a large scale, but it is not necessary to deal with them here.

The forms of this collaboration are numerous. They include, in the first place, inter-governmental contracts for scientific collaboration, in which biological problems should play a more important role. Also included are scientific committees and groups at UNESCO, FAO, the World Health Organization, the International Atomic Energy Agency and other special organizations of the UN.

The contribution of non-governmental international organizations is also an important one. It is worth mentioning here the modest, useful activity of our own Pugwash Movement, of the World Federation of Scientific Workers and the special international unions of biologists.

The contributions of the different scientific congresses, conferences and symposia on biology are also valuable.

We have mentioned above only some problems and forms of scientific collaboration in the field of biology among different countries. It is evident that this collaboration should be developed to include more countries, taking into consideration the favourable climate on our planet. The forms of collaboration should be filled with more content. There are favourable prospects for this.

In establishing international scientific collaboration, biologists must be active in the search for more suitable methods and forms of close cooperation, so that the efforts of all scientists can be united with a view to finding solutions to the complicated biological problems which now wait for the warm rays of science to elucidate them. Thus, we shall do our duty and we shall contribute to placing science, this great creative force, at the service of peace and the welfare of mankind. Biology, the science of life, should serve life, its development and progress.

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IAEA EXPERIENCE IN SAFEGUARDS IN RELATION TO THE NPT  
AND THEIR FURTHER PROSPECTS

The Non-NPT Safeguards System

The development of a system of safeguards by the IAEA began in the early years of the Agency's existence. The system, as formulated prior to the advent of the Treaty on the Non-Proliferation of Nuclear Weapons, underwent a number of revisions. It is now known as the Agency's Safeguards System (1965, as provisionally extended in 1966 and 1968) and is contained in document INFCIRC/66(Rev.2). It is primarily facility oriented, having originally been developed in the first place to serve in connection with project agreements, safeguards transfer agreements or unilateral submission agreements, which as a rule pertain to single facilities or to a limited number of facilities rather than to all of a State's nuclear activities. In fact, under a safeguards agreement pursuant to INFCIRC/66 a State may put a single facility under Agency safeguards while retaining unsafeguarded all or part of a nuclear fuel cycle. The system provides that nuclear material supplied under project agreements or submitted to safeguards under a safeguards transfer or unilateral submission agreement shall be subject to safeguards as well as nuclear material produced, processed or used in a facility which has been supplied under project agreements or submitted to safeguards under the various other types of agreement.

The stated purpose of INFCIRC/66 is to establish a system of controls to permit the Agency to comply with the obligation in the Statute providing that the Agency shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy.

Most of the agreements under this system transferred to the Agency the execution of safeguards commitments included in bilateral co-operation agreements. In 1970 a total of 32 States were involved in 44 safeguards agreements with the IAEA. Annex 1 which reflects the growth of safeguards from the beginning up to the present, illustrates the extent to which safeguards had grown when NPT came into force.

The Non-Proliferation Treaty

Upon the entry into force of the NPT, the Director General, in March 1970, advised Member States of the considerable preliminary work which had been done and was underway in the Secretariat bearing upon the manner in which the Agency could fulfil its responsibilities under the Treaty.

In April 1970 the Agency's Board of Governors established a committee, on which any Member State of the Agency could be represented, to advise it as a matter of urgency on the Agency's safeguards responsibilities in relation to NPT and in particular on the content of the agreements which non-nuclear weapon States party to NPT are required to conclude with the Agency under Article III thereof. Delegations from 48 Member States participated in the Committee's work. The Committee met from 12 June 1970 to 10 March 1971, holding 82 meetings. Its report consisted of recommendations for the contents of safeguards agreements, including a first part relating to the basic legal, financial and administrative obligations of the State and the Agency and a second part setting out in detail the technical safeguards procedures to be followed. On 20 April 1971 the Board requested the Director General to use this material as the basis for negotiating agreements required by Article III of NPT. The text has been issued as Agency document INFCIRC/153.

Some Basic Concepts on the Safeguards Agreements in Connection with NPT

Both document INFCIRC/66 and document INFCIRC/153 contain the basic principle that safeguards shall be implemented in a manner designed to avoid hampering the economic and technical development of the State (this principle is contained in the Non-NPT System also) or international co-operation in the field of peaceful nuclear activities including international exchange of nuclear material. The Agency aims at establishing and applying an impartial, objective and widely acceptable safeguards system, and one which is non-discriminatory as between the Parties.

Safeguards are to be applied to all nuclear material in all peaceful nuclear activities but are concerned only with verifying that there is no diversion of nuclear material from peaceful uses to nuclear weapons or other nuclear explosive devices. An important and novel feature of the Agency's safeguards in connection with NPT, is the formal requirement for the State to establish its own system of accounting for and control of all nuclear material subject to safeguards.

Safeguards are to be applied in such a way that the Agency in the process of ascertaining that there has been no diversion, may verify findings of the State's system. The Agency's verification shall include independent measurements and observations conducted in accordance with procedures laid down in detail in the agreement. The Agency's verification activities are limited to those locations where nuclear material is reported to be present.

The objective of safeguards as stated in safeguards agreements is the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection.

The safeguards measure of fundamental importance is material accountancy, based on a system of so called "material balance areas." The material balance area is a functional concept intended to facilitate the control of movement of material into or out of, and the determination of the material balance in, a given area. The material balance area can be a part of a facility, it can be coincident with a facility or it can consist of several facilities. The use of the concept permits safeguards to be concentrated on key measurement points where the flow or inventory of nuclear material may be determined. Under the material accountancy approach the Agency is informed, from records and by means of reports, of changes in the inventory of nuclear material in the material balance area. It can thus establish the book inventory for each such area and by verifying that this is consistent with the actual situation the Agency can detect possible diversion that might be hidden by falsified accountancy. Periodically physical inventories are taken by the operator and verified by the Agency. The difference that may arise between the book inventory and the physical inventory at the end of a period for which the material balance is established is the so-called "material unaccounted for". The significance, in absolute and relative terms, of this amount, and its limits of error, serve as an indication as to whether diversion may be taking place and determines the need for any further action, including subsequent investigation. The Agency's verification activities thus lead to a statement in respect of each material balance area for the amount of material unaccounted for in that area over a specific period and of the accuracy with which this amount is known.



Material accountancy is complemented by containment and surveillance measures. For containment use is made of the structural features of the facility, amplified as appropriate by such devices as seals to ensure the actual presence of nuclear material where this is reported to be. Surveillance employs methods such as the use of unattended optical and other instruments to ascertain whether the material flow is as reported.

The starting point for the application of safeguards is set at a stage in the fuel cycle where nuclear material reaches such purity and composition as to make it potentially suitable for nuclear use.

The agreement provides that when nuclear material is exported from the State, safeguards in respect of that material terminate as far as the State in question is concerned. A system of advance notifications and of reports is included to ensure that the Agency has knowledge of the destination of the exported material.

It should be noted that Article III.2 of NPT places all States party to the Treaty under the same basic obligation not to export source or special fissionable material or equipment or material especially designed or prepared for the processing, use or production of special fissionable material to any non-nuclear-weapon State unless the source or special fissionable material involved shall be subject to safeguards. In July 1974 the Governments of the United Kingdom, the Soviet Union and the United States advised the Director General that they would henceforth provide the Agency on a continuing basis with information regarding exports and imports of nuclear material out of and into the three respective countries. This adds to the credibility of Agency safeguards activities in non-nuclear weapon States. The text of the three identical letters is attached. (Annex 2)

The requirements for reports to the Agency on safeguarded nuclear material are set forth in the agreement and elaborated in so called Subsidiary Arrangements, which specify in detail, for each facility, how the procedures laid down in the agreement are to be implemented and where surveillance and containment measures are to be applied. These Subsidiary Arrangements also indicate the so called strategic points to which routine inspections are to be confined as well as the key measurement points where material flow or inventory are determined.

The maximum inspection effort that may be devoted to the various categories of facilities is defined in the agreement. It also contains criteria to determine the actual routine inspection effort to be applied.

Present Status

The application of safeguards under an agreement concluded pursuant to INFCIRC/66 is suspended while an agreement pursuant to NPT is in force with the State concerned, but the original agreement remains in existence. It is worth noting, however, that since the entry into force of NPT a number of additional agreements have been concluded under the INFCIRC/66 System with States that are not party to the Treaty.

As of [ 1 June 1974 ] the situation regarding the signature and ratification of the NPT, and the conclusion of safeguards agreements with the Agency in connection with the Treaty, was as follows:

Number of non-nuclear-weapon States that had signed NPT	[ 95 ]
Number of non-nuclear-weapon States party to NPT	[ 79 ]
Number of non-nuclear-weapon States that had concluded the required safeguards agreements	[ 43 ]
Number of safeguards agreements in force	[ 32 ]

Thus 54% of the non-nuclear-weapon States party to NPT had concluded the required safeguards agreements with the Agency, including almost all the non-nuclear-weapon States that have any significant nuclear activities. Annex 3 gives further details of the status of NPT safeguards agreements with non-nuclear-weapon States, including States with which negotiations are proceeding. Annex 4 shows the situation with respect to each signatory State. The Agency is actively placing its services at the disposal of Member States in helping them to conclude the safeguards agreements required by the NPT.

The following approaches have been adopted in connection with certain given situations:

- (i) With States that neither have nuclear material exceeding the quantitative exemption limits given in the agreement nor nuclear material in a facility, a protocol is concluded which has the effect of deferring the application of safeguards until the State has in its territory or under its jurisdiction or control a quantity of nuclear material exceeding those limits.
- (ii) In the case that the State is a party both to the NPT and the Treaty for the Prohibition of Nuclear Weapons in Latin America (the Tlatelolco Treaty), the preamble of the agreement refers to both Treaties. The duration clause provides that the agreement remains in force as long as the State is a party to either or both Treaties. Alternatively, a special protocol to the NPT agreement has been concluded.
- (iii) The agreement with the non-nuclear-weapon States members of the European Atomic Energy Community and the Community itself (not yet in force) is accompanied by a protocol which takes account of the existence of the Euratom safeguards system by specifying conditions and means for co-operation in the application of safeguards between the two organizations.
- (iv) The text contained in INF/CIRC/153 has also been used as the basis for an agreement with a State that is a Party to the Tlatelolco Treaty only, with some adaptations necessary to take care of "exports" and "non-explosive military use", in regard to which that Treaty differs from the NPT.
- (v) It has to be remembered that the obligations of States party to agreements under INF/CIRC/66 go beyond those arising from the NPT, in the sense that such agreements not only prohibit the use of the items covered by the safeguards agreement for development and manufacture of any nuclear explosive device but also in any other activity that furthers a military purpose. When an agreement under INF/CIRC/66 remains suspended, because a State has concluded an agreement under the NPT, the undertaking under the former not to further any military purpose remains valid nevertheless, even though the undertaking pertains to specified nuclear material, equipment and facilities.

## Development

The Agency's safeguards development work is aimed at making the implementation of safeguards as effective, economical and unintrusive as possible. This is being achieved, in particular, by the improvement of the IAEA safeguards information handling system, the establishment of analytical services - utilizing laboratories in Member States - the development of non-destructive assay techniques, and the use of equipment that will both improve results of verification and reduce the need for human surveillance. The technical effectiveness of safeguards increases with the ~~past~~ experience the Agency acquires by the implementation of both systems, as well as with the adoption of new methods, techniques and new equipment.

The physical protection of nuclear material is an essential supplement to the State's national system of accounting for and control of nuclear material. The establishment and implementation of a physical protection system within a State is recognized by the Agency as being the responsibility of that State. Further, it follows from the provisions of INFCIRC/153 that the responsibility for physical protection of safeguarded nuclear material in the case of international transfers is a matter for agreement between the States concerned. However, the Agency has assumed an advisory role in this area. With the help of consultants and of a panel in 1971 and 1972, it has drawn up guidelines on the matter, and a set of recommendations was published and made available upon request to about fifty States (See Annex 5).

## Further prospects

The political strengthening of the NPT, in the sense of its wider acceptance and adherence by many more countries, seems to depend preponderantly on two factors:

- (a) the absence of international tensions leading to the prevalence of a feeling of international stability and security; and
- (b) significant progress in disarmament commencing with nuclear weapons followed by conventional ones.

A climate of international peace and stability inevitably generates a feeling of security, and provides probably the best psychological deterrence to the stockpiling of arms and the build-up of military potential. Such a climate would induce those States, which now wish to keep their nuclear option open because of unstable political conditions, to become parties to the NPT.





In the personal opinion of the authors the achievement of international stability is not possible in a world engaged in a reckless arms race. A stand-still in the stockpiling of arms followed by reductions is an absolute pre-requisite for attaining such stability.

The consensus of informed opinion is that a start must be made in nuclear disarmament followed by reductions in conventional arms. The primary responsibility for taking the initiative in nuclear disarmament is that of the Super Powers, both of which are reported to have "over-kill" capacity. Unfortunately, their efforts as reflected in the agreements following their Strategic Arms Limitation Talks, undertaken in pursuance of Article VI of the NPT, do not inspire the requisite confidence that tangible progress is being made in disarmament. The SALT-1 Agreements set limits on the numbers of missiles for each of the two sides but not on the numbers or sophistication of nuclear war-heads. As one learned analyst of the SALT-1 Agreements put it "we have now a strange situation in which MIRV nuclear warheads increase in number and in destructive capabilities as a result of a successful disarmament treaty." For a meaningful start all the nuclear weapon States must agree on a comprehensive test ban and on a complete cut-off of the production of special fissionable material for weapon purposes. The development and sophistication of the low-yield tactical nuclear weapons by the Super Powers (the so called mini-nukes) is a very alarming move. If the nuclear weapon States despite their strategic nuclear capability, consider that these are necessary, how is one to convince the non-nuclear-weapon States that they are not necessary to them also? What is the guarantee that the size of the weapons will not escalate? Informed opinion holds that the lack of progress in nuclear disarmament weakens the NPT. It is believed that some countries, which are on the threshold of either signing or ratifying NPT, are hesitating to do so. The alarming rate of vertical proliferation of nuclear weapons is causing serious concern to the adherents of the NPT, who had hoped that the NPT would be a fore-runner of more effective nuclear disarmament measures. Valuable time is being lost, and with each day the solution of the problems inevitably becomes more difficult.

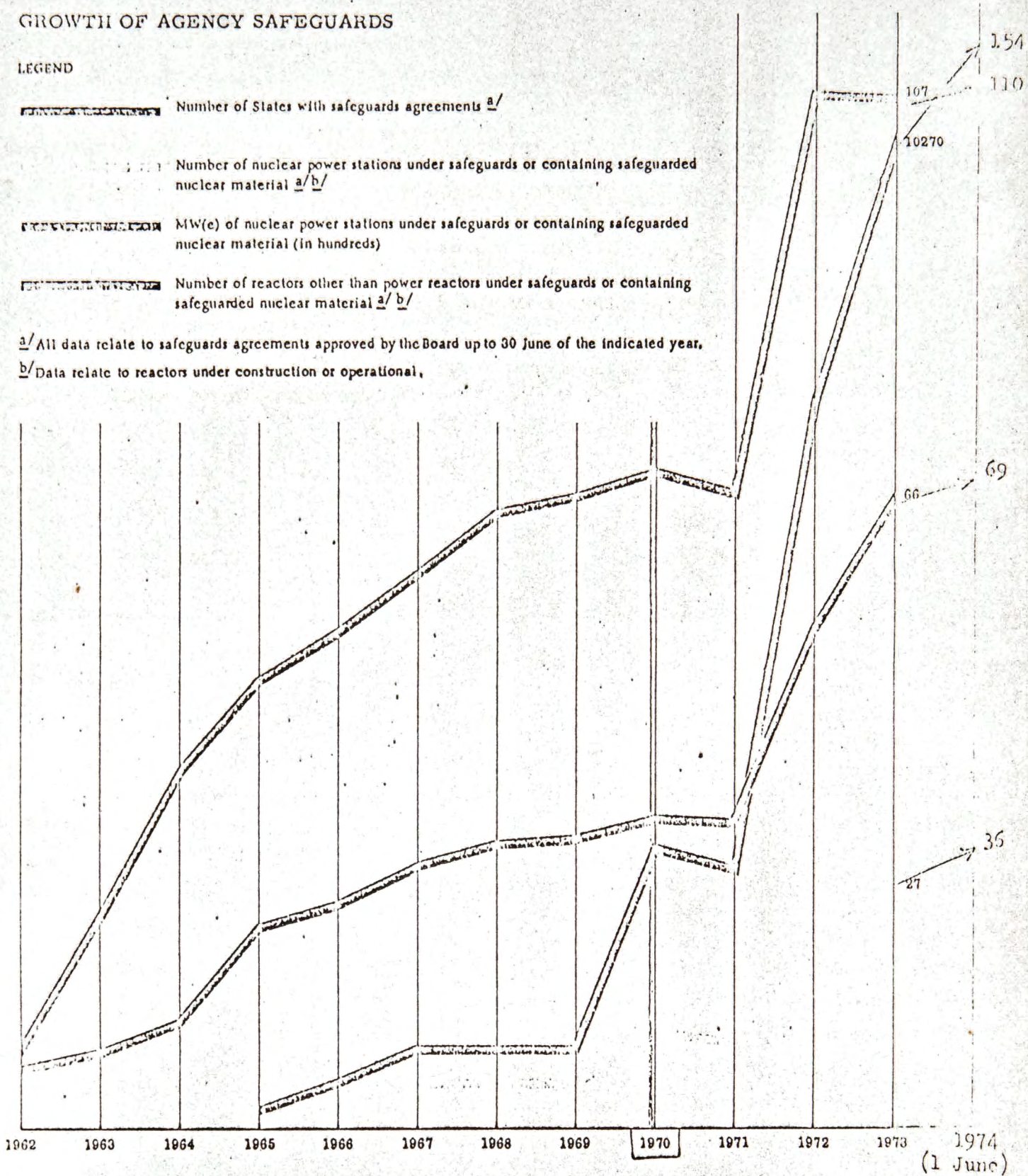
An alternative method of obtaining wider acceptance of and adherence to the NPT would be for the industrialized nations to make it a precondition for the supply of nuclear reactors and other nuclear plants that the recipient country must be party to the NPT. This approach, however, is of dubious value because of the withdrawal clause in the NPT. After receiving the reactors or nuclear plants a country could renounce the NPT on the grounds, or even on the pretext, of national security considerations. In the ultimate analysis a pre-condition of the above nature, if unaccepted, can at best only delay a country in its determination to acquire nuclear weapons capability. Persuasion rather than coercion seems to be indicated for the success of the NPT. But there can be no doubt about the futility of any measure to strengthen the NPT in the absence of a desire on the part of the nuclear weapons States to abjure nuclear weapons altogether.

GROWTH OF AGENCY SAFEGUARDS

LEGEND

-  Number of States with safeguards agreements a/
-  Number of nuclear power stations under safeguards or containing safeguarded nuclear material a/b/
-  MW(e) of nuclear power stations under safeguards or containing safeguarded nuclear material (in hundreds)
-  Number of reactors other than power reactors under safeguards or containing safeguarded nuclear material a/ b/

a/ All data relate to safeguards agreements approved by the Board up to 30 June of the indicated year.  
b/ Data relate to reactors under construction or operational.





International Atomic Energy Agency

## INFORMATION CIRCULAR

INFCIRC/207

26 July 1974

GENERAL Distr.

Original: ENGLISH and  
RUSSIANNOTIFICATION TO THE AGENCY OF EXPORTS AND IMPORTS OF  
NUCLEAR MATERIAL

On 11 July 1974 the Director General received letters dated 10 July from the Resident Representatives to the Agency of the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland and the United States of America informing him that in the interest of assisting the Agency in its safeguards activities, the Governments of these three Members had decided to provide it henceforth with information on exports and imports of nuclear material. In the light of the wish expressed at the end of these letters their text is reproduced below.

I am pleased to inform you that my Government, in the interest of assisting the IAEA in its safeguards activities, has decided that the Agency should be provided on a continuing basis with the following information:

- (1) With respect to the anticipated export of nuclear material (excluding exports of source material for non-nuclear purposes), in an amount exceeding one effective kilogram, for peaceful purposes to any non-nuclear-weapon State:
  - (a) The organization or company which will prepare the nuclear material for export;
  - (b) The description, and if possible the expected composition and quantity, of nuclear material in the anticipated export;
  - (c) The State and organization or company to which the nuclear material is to be exported and, where applicable (i. e. in those cases in which nuclear material is processed further in a second State before retransfer to a third State), the State and organization or company of ultimate destination.

The foregoing information will be provided normally at least ten days prior to export of the material from my country; confirmation of each export, including actual quantity and composition and date of shipment, will be provided promptly after shipment;

- (2) With respect to each import, in an amount greater than one effective kilogram, of nuclear material which, immediately prior to export, is subject to safeguards, under an agreement with the IAEA, in the State from which the material is imported:
  - (a) The State and organization or company from which the nuclear material is received;
  - (b) The description, composition and quantity of nuclear material in the shipment.



The information described above will be provided as soon as possible after receipt of the material.

It is intended that the provision of the information described above will be initiated as soon as possible and not later than 1 October 1974. The details of these arrangements can be discussed with you or your staff whenever convenient.

My Government would appreciate this information being brought to the attention of all Members of the Agency by means of an information circular.

ANNEX 3

Situation as of 1 June 1974 with respect to ratification of (or accession to) NPT by Non-Nuclear Weapon States and status of negotiations of safeguards agreements between the Agency and those States in connection with the Treaty

I. Total number of NNWS having ratified NPT (or acceded to it):

79 States of which:

23 States have "significant" nuclear activities.

56 States do not have "significant" nuclear activities.

II. Status of NPT Safeguards Agreements with NNWS\*:

Agreements	NNWS with significant nuclear activities	NNWS without significant nuclear activities	Total
In force	19	13	32
Signed but not yet in force	2	4	6
Approved by Board of Governors but not yet signed	1	4	5
Under negotiation	1	18	19
No formal request for negotiation	-	17	17
<b>Total</b>	<b>23</b>	<b>56</b>	<b>79</b>

\* For identification of the States concerned, see attached table.

ANNEX 4

Situation on 1 June 1974 with respect to the signature of, ratification of, or accession to, NPT<sup>a</sup> by non-nuclear-weapon States, and the conclusion of safeguards agreements between the Agency and these States in connection with NPT

Non-nuclear-weapon States which have signed, ratified or acceded to NPT <sup>a</sup> (1)	Date of ratification or accession <sup>a</sup> (2)	Safeguards agreement with the Agency (3)
Afghanistan	4 February 1970	Under negotiation
Australia	23 January 1973	Approved by the Board
Austria	28 June 1969	In force: 23 July 1972
Barbados		Under negotiation
Belgium		Signed: 5 April 1973
Bolivia	26 May 1970	Approved by the Board
Botswana	28 April 1969	Under negotiation
Bulgaria	5 September 1969	In force: 29 February 1972
Burundi	19 March 1971	
Cameroon	8 January 1969	
Canada	8 January 1969	In force: 21 February 1972
Central African Republic	25 October 1970	
Chad	10 March 1971	
China, Republic of	27 January 1970	
Colombia		
Costa Rica	3 March 1970	Signed: 12 July 1973
Cyprus	16 February 1970	In force: 26 January 1973
Czechoslovak Socialist Republic	22 July 1969	In force: 3 March 1972
Dahomey	31 October 1972	
Denmark	3 January 1969	In force: 1 March 1972
Dominican Republic	24 July 1971	In force: 11 October 1973
Ecuador	7 March 1969	Under negotiation
Egypt, Arab Republic of		
El Salvador	11 July 1972	Under negotiation
Ethiopia	5 February 1970	[Under negotiation]
Fiji	14 July 1972	In force: 22 March 1973
Finland	5 February 1969	In force: 9 February 1972
Gabon	19 February 1974	Under negotiation
Gambia		
German Democratic Republic	31 October 1969	In force: 7 March 1972
Germany, Federal Republic of		Signed: 5 April 1973
Ghana	5 May 1970	Signed: 23 August 1973
Greece	11 March 1970	Provisionally in force: 1 March 1972
Guatemala	22 September 1970	Under negotiation
Haiti	2 June 1970	Approved by the Board
Holy See	25 February 1971	In force: 1 August 1972
Honduras	16 May 1973	Under negotiation
Hungary	27 May 1969	In force: 30 March 1972
Iceland	18 July 1969	Signed: 12 July 1972
Indonesia		
Iran	2 February 1970	In force: 15 May 1974
Iraq	29 October 1969	In force: 29 February 1972
Ireland	1 July 1968	In force: 29 February 1972
Italy		Signed: 5 April 1973
Ivory Coast	6 March 1973	
Jamaica	5 March 1970	Under negotiation
Japan		
Jordan	11 February 1970	Under negotiation
Kenya	11 July 1970	Under negotiation
Khmer Republic	2 June 1972	
Korea, Republic of		

[ ] no formal request for negotiation.

(1)	(2)	(3)
Kuwait		
Laos	20 February 1970	Under negotiation
Lebanon	15 July 1970	In force: 5 March 1973
Lesotho	20 May 1970	In force: 12 June 1973
Liberia	5 March 1970	
Libyan Arab Republic		
Luxembourg		Signed: 5 April 1973
Madagascar	8 October 1970	In force: 14 June 1973
Malaysia	5 March 1970	In force: 29 February 1972
Maldives	7 April 1970	Under negotiation
Mali	5 March 1970	Under negotiation
Malta	6 February 1970	Under negotiation
Mauritius	28 April 1969	In force: 31 January 1973
Mexico	21 January 1969	In force 14 September 1973
Mongolia	14 May 1969	In force: 5 September 1972
Morocco	30 November 1970	Signed: 30 January 1973
Nepal	5 January 1970	In force: 22 June 1972
Netherlands		Signed: 5 April 1973
Netherlands Antilles and Surinam		Signed: 5 April 1973
New Zealand	10 September 1969	In force: 29 February 1972
Nicaragua	6 March 1973	Approved by the Board
Nigeria	27 September 1968	Under negotiation
Norway	5 February 1969	In force: 1 March 1972
Panama		
Paraguay	4 February 1970	
Peru	3 March 1970	[Under negotiation]
Philippines	5 October 1972	Signed: 21 February 1973
Poland	12 June 1969	In force: 11 October 1972
Romania	4 February 1970	In force: 27 October 1972
San Marino	10 August 1970	Under negotiation
Senegal	17 December 1970	[Under negotiation]
Sierra Leone <sup>b/</sup>		Under negotiation
Singapore		
Somalia	5 March 1970	Under negotiation
Southern Yemen		
Sudan	31 October 1973	
Sri Lanka		
Swaziland	11 December 1969	Approved by the Board
Sweden	9 January 1970	Under negotiation
Switzerland		Under negotiation
Syrian Arab Republic	24 September 1969	
Thailand	7 December 1972	In force: 16 May 1974
Togo	26 February 1970	
Tonga	7 July 1971	Under negotiation
Trinidad and Tobago		
Tunisia	26 February 1970	[Under negotiation]
Turkey		
Upper Volta	3 March 1970	
Uruguay	31 August 1970	Signed: 24 September 1971
Venezuela		
Viet-Nam	10 September 1971	In force 9 January 1974
Yemen, Arab Republic of		
Yugoslavia	3 March 1970	In force 28 December 1973
Zaire, Republic of	4 August 1970	In force: 9 November 1972

a/ The information reproduced in columns (1) and (2), with the exception of that relating to Sierra Leone, was provided to the Agency by the depositary Governments of NIFT, and an entry in column (1) does not imply the expression of any opinion on the part of the Secretariat concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

b/ Has not yet acceded to NIFT.

ANNEX 5

Guidelines for the Physical Protection of Nuclear  
Material against Loss, Theft, etc.

[This document is distributed as a separate publication]

PROSPECTS FOR EUROPEAN SECURITY AND CO-OPERATION  
IN THE NEAR AND MORE DISTANT FUTURE

In this paper I want to consider problems of European disarmament and security. Compared with the situation about 10 years ago (it is useful to re-read the relevant papers at the 11th and 13th Pugwash Conferences of 1963 and 1964), I want to stress the importance of considering the possibilities for European disarmament today in the context of the social, political and cultural development of Europe, and not just as an isolated topic restricted to the military situation. If we realize the strong interaction between different aspects of development in Europe, we may be able to formulate more effective proposals for improving the European situation with respect to armaments, as well as other aspects.

I Considering the political development of Europe since World War II, we note:

1. The period 1945-1955 was primarily a "cold war period"; the antagonistic relations between U.S.A. and U.S.S.R. were reflected in a sharp division, the "iron curtain", in Europe. The precarious relations between the different parts into which the former Germany had been divided also formed, in itself, a source of tensions. Further, the fall of Hitler's "Dritte Reich" left a rather chaotic situation in Central Europe.
2. Since about 1955 the relations between Eastern and Western Europe have gradually improved, although this process has had certain ups and downs. The economic and cultural relations between Eastern and Western Europe have been intensified; the military and political situation has become less tense. Strongly related to the situation in Europe is the relation between U.S.A. and U.S.S.R., which has also gradually improved in this period.
3. The normalization of the relations between B.R.D. (Federal Republic Germany) and D.D.R. (German Democratic Republic) in 1972 and 1973 has mostly removed the "problem of the division of Germany" as a constant source of political tension in Europe. We may note that the "German problem" was thoroughly discussed at the 11th and 13th Pugwash Conferences and that recommendations with respect to Germany were made in 1964 by Working Group 1 of the 13th Pugwash Conference, to which the political agreements of 1972 are very close.

4. Decolonization has been a further important gradual process, in which the countries of Western Europe had to give up position of (out-dated) power and had to liberate themselves from the burdens of the past. The last colonies to become independent (of Portugal) are doing so only now - in 1974! This does not mean that the problems of the former colonies are solved: many of the former colonies are now poor, developing countries with immense problems with respect to food, population growth, employment, etc.
5. Regional organizations, mainly for improving economic co-operation between different countries, have come into existence in Western and Eastern Europe, in particular E. E. C. (European Economic Community) and Committee for Mutual Economic Aid (also known as Comecon). It is clear that, on the one hand, the smaller European nations are too small to exist as independent economic entities. On the other hand, the history of regional organizations is as much one of failure as of success.

Considering the development of these issues over the past 10 years, we may note how slow the really big issues develop and how long the path is from proposals for improvement made by a small group of people to their eventual political realization.

II With regard to nuclear weapons and the military situation in Europe, a concise review of developments is, for example, given in the SIPRI monograph "Force Reductions in Europe" <sup>3</sup> (especially in Ch. 2), to which we may refer for many details. The military situation between NATO and WTO countries presents a certain symmetry and even a certain stability. At the moment, it seems that the situation in Europe is not a major source of tensions in the world. On the other hand, vast amounts of money are still spent by the European nations on military purposes, which could be spent in far more constructive ways.

With respect to the local situation of (nuclear) disarmament in Europe, there have been both a number of successes and a number of failures during the recent past. Among the successes is the fact that the number of countries which possess and manufacture nuclear weapons independently has certainly been restricted as a consequence of the nuclear 'test-ban treaty' and the 'non-proliferation treaty'.

Further, the fact that the M. L. F. (Multi-Lateral Force), which was considered seriously by NATO about 1964, was not established has in a certain way avoided a possible additional route toward nuclear proliferation, and may have improved the relations between U.S.A. and U.S.S.R. (cf. e.g. ref 2, pp. 33, 34).

Proposals with respect to (nuclear) disarmament in Europe, which have repeatedly been made or are now under discussion, include:

- (a) zones with reduced nuclear or conventional armaments;
- (b) mutual force reductions by NATO and WTO countries.

(The history and present situation in this respect is given e.g. in refs 1, 2, 3, 4.)

We consider both these proposals as desirable goals, if they can be realized in a suitable form. We do not want to go into a more detailed discussion of these proposals than has been given already in refs 1, 2, 3, or 4. However, in the last part of this paper we want to point out a number of possible future developments and trends, which may be favourable in themselves, and which could, in addition, make easier steps toward European disarmament by building up mutual trust.

### III Potential developments and desirable aims for Europe in the future

We want to mention the following possibilities as to the future developments in Europe. They deserve to be discussed thoroughly, due to their impact in building up mutual trust between Eastern and Western Europe, a mutual trust which may, in turn, catalyze mutual military force reductions in Eastern and Western Europe:

1. It is clear that most smaller European nations as economic units are too small for independent economic planning. Certain forms of economic planning embracing Western as well as Eastern Europe seem desirable. The possibilities of adopting 4 or 5 year plans extending to the whole of Europe should be seriously discussed. In the recent past E.E.C., Comecon and certain international treaties have certainly increased international planning; on the other hand, these organizations have also known many failures and definitely need to be improved in many respects.
2. Amongst the desirable aims of European (economic) planning we mention:
  - (a) full employment while avoiding numerous migrations of "guest workers" from, e.g., Spain, southern Italy and southern Yugoslavia to more northern countries in Europe; this will require substantial capital investments in certain areas of Europe.
  - (b) responsible planning for the whole of Europe covering the following elements:
    - energy policy; environmental pollution; the use of raw materials;
    - population policy aiming at approximately stationary population; a cut in military budgets, in a balanced way for Eastern and Western Europe



(such a cut would in turn allow increased aid from Europe to developing countries).

3. Generally speaking, the growth of a form of federal structure for the whole of Europe seems desirable, on condition that this does not suffocate the justified desires of any separate country or region. E.E.C. and Comecon are examples at the economic level of certain forms of regional organizations. It might be that on a military level the building of a European Security System could be done better by transforming NATO and WTO into components for mutual information and decision making in Europe, rather than by abolishing NATO and WTO immediately.
4. The fact that substantially different political systems coexist in Western and Eastern European countries must be recognized; on the other hand, there exists a kind of "cultural heritage" common to all European countries. An extensive exchange of persons and ideas is considered by many people as an essential condition for building up mutual trust. A topic of this importance must certainly be discussed thoroughly.
5. Certain adjustments may be quite feasible also amongst countries with different political systems either in the near or more distant future, e.g.:
  - (a) synchronizing periods of economic planning in various European countries;
  - (b) systems of currency exchange amongst the European nations.
6. Certain local conflicts, which may have a negative influence on the stability of the European situation occur more or less at the borders of Europe, e.g.:
  - (a) the Arab-Israel conflict;
  - (b) the Cyprus conflict.

It would be very desirable for European security and stability if some settlement for these conflicts could be found.

In part III of this paper we have listed a number of topics which, we want to emphasize, have strong ties to the problems of European Security and Disarmament. We have in this paper discussed their connection to European Security. They must, however, also be taken into consideration when discussing Disarmament .

References

1. Proc. 11th Pugwash Conference on Science and World Affairs (Dubrovnik, 1963) (especially papers on page 24, 31, 85, 89, 126, 132, 148, 158, 169, 201, 261, 265, 276).
2. Proc. 13th Pugwash Conference on Science and World Affairs (Karlovy Vary, 1964) (especially papers on page 27, 30, 86, 89, 101, 145, 182, 188, 192, 214, 236, 284, 295, 326, 331, 335).
3. Force Reductions in Europe (SIPRI monograph), SIPRI, Stockholm 1974.
4. 19th Pugwash Symposium "The political situation in Europe: the arms race and prospects for disarmament". Cracow, Poland, April 4-8, 1974.

HAVES AND HAVE-NOTS IN THE NEAR EAST AND NORTH AFRICA +)

Erhard Eppler, the former minister for economic development of the Federal Republic of Germany, has pointed out recently that since the oil crisis of 1973 one has to distinguish between four types of developing countries:

- 1) developing countries with considerable oil resources
- 2) developing countries with considerable raw material deposits
- 3) developing countries at a comparatively advanced level of industrialization, and
- 4) developing countries which possess none of the above cited characteristics, and which must be considered the true have-nots among the developing nations.

In evaluating the economic status of the nations located in the Near East and North Africa one would do well to apply Mr. Eppler's system of classification. With the exception of category 2, all types of developing nations can be found in this region. In 1972 its oil production amounted to 30,9 percent, i.e. almost one third of world production. It was shared by the various Arabic countries in the following way:

Oil production in the Near East in 1972

	in Mill. tons
Saudi Arabia	285,5
Kuwait	151,2
Libya	106,7
Iraq	71,6
Algeria	52,0
Abu Dhabi	50,6
Qatar	23,2
Oman	14,2
Others	<u>47,2</u>
Total	802,2

+ ) The statistical data used in this article are derived mainly from various U.N. publications. Another useful source is the bulletin on "The Middle East and North Africa" by the Europa Publications Limited, London.

If we consider the oil revenues of all OPEC countries which comprise besides the Arabic states such major producers as Iran, Venezuela and Nigeria, they are likely to be higher in 1974 by some 50 to 60 billion dollars than in the previous year. While it is uncertain whether oil prices can be maintained at their present high level in the near future, revenues from oil exports will continue to be high in the years to come. This is bound to alter drastically the economic and political status of the oil producing countries in the world community, even though none of the major oil producers of the Near East can be expected to set out on a course of rapid industrialization without first modernising its economic and social infrastructure. As in other regions of the world, industrialization in the Near East will undoubtedly prove to be a time-consuming and tortuous process.

There are only a few countries in the Near East and North Africa which can be considered to belong to category 3. Foremost among these is the State of Israel which has attained a level of industrialization which calls into question the present practice of counting it among the developing nations. No matter what criteria are used (G.N.P. per head or percentage of active population engaged in industry and commerce), it would seem more justified to regard Israel as part of the advanced industrial world.

Countries at a comparatively advanced level of economic development in a more proper sense are Lebanon, Egypt and Algeria. Among these only Lebanon enjoys a comparatively high national income per head of population (approx. \$ 660,-- in 1971) which is due to its diversified structure of the economy, especially to the wide range of services such as commercial, banking and tourist services. With the expansion of industrial activity in the Near East and the massive inflow of oil-revenues the importance of Lebanon as a commercial intermediary is bound to increase.

While Egypt with its rapidly rising population must still be counted among the poorer nations of the Near East (G.N.P. \$ 220,-- in 1971), it has made considerable and promising efforts in recent

years to expand its industrial production. On completion of its current ten-year plan the government hopes to step up steel output from its present 450.000 tons a year to 2 million tons a year, cement from 3,6 million tons to 6 million, crude oil from 15 million tons to 60 million, and electric power from 7.000 million kWh to 19.000 million kWh.

Noteworthy is the prospective steep rise in oil output which no doubt will help Egypt to finance part of its ambitious industrial programme. Revenues from oil exports will not, however, be large enough to provide sufficient financial underpinning for its growing economy. Foreign aid will continue to play a significant role; part of this may be provided by oil-rich Arabic countries as the recent financial offers by King Faisal of Saudi Arabia seem to indicate.

Algeria's economic position is similar to that of Egypt. Its national income per head (\$ 360,-- in 1971) is higher by about  $\frac{1}{3}$  but it, too, has embarked on an ambitious programme of industrialization which <sup>it</sup> will be able to finance to a considerable extent from its oil and natural gas revenues. Exports of raw materials and agricultural products will bring in additional foreign exchange, but will hardly be large enough to make Algeria entirely independent of foreign aid. Promises of substantial aid from Arabic sources have so far been lacking.

Lastly, there are a few countries in the Near East and North Africa which may be considered the true have-nots of the region, since they possess neither oil, nor other raw materials, nor have so far made noteworthy efforts at the industrialization of their economies. Syria, Jordan, the two Yemens, Tunisia, Sudan and to a lesser extent Morocco must be regarded as members of this group. With the exception of Syria and Morocco which have considerable natural resources, this group lacks the prerequisites for quick industrial growth, unless it is generously supported in its efforts by its rich neighbours and by industrially advanced countries.

The recent steep increase in oil prices has also accentuated the difficulties of those developing countries in the Near East which lack oil or other national riches. The quadrupling of the oil price within a year, has adversely affected not only the cost of energy, but also that of fertilizers and ultimately, the prices of various food-stuffs. Moreover, by worsening the inflationary climate of the industrially advanced nations, the rise in the price of oil has led to a further increase in the price of industrial commodities. It has been estimated that the total cost arising from higher oil prices, dearer food-stuffs and industrial products has more than offset current development aid received by the developing countries from the more advanced countries. In consequence, the situation of some of the have-not nations has become truly critical.

Tentative plans have been drawn up with the intention of alleviating the financial crisis which most of the developing countries are undergoing at present. OPEC has announced the founding of a development bank for the explicit purpose of extending aid to developing countries which are faced with heavy balance of payment deficits. Other schemes propose the strengthening of existing international institutions such as IMF, IDA and others, by enlarging their capital base through the infusion of capital from oil producing countries.

To the knowledge of this writer, OPEC, the Organization of Arabic Oil Exporting Countries, has so far refrained from pursuing multilateral schemes designed to bring aid to the Arabic have-not countries. On the other hand, aid on a bilateral basis seems to have been forthcoming in generous proportions. A case in point is the recent offer to Egypt by Faisal of Saudi Arabia mentioned above. It is, of course, difficult to judge how much of such aid is earmarked for military purposes, and how much is meant to meet purely economic needs.

At present, where the chances of war and peace seem to be evenly balanced, the emergence of a genuine multilateral aid organization in the Near East, to which the oil-rich countries as

well as Israel could contribute capital and know-how, must be deemed highly unlikely. For the time being, the present haphazard system of bilateral aid with its known drawbacks will no doubt be continued. Under its auspices political affinities between states will count more than rationally established economic priorities.

The emergence of a genuine peace would, of course, drastically alter the economic prospects of the whole region. First, it would immediately lift the enormous military burden from countries like Egypt, Syria, Algeria, Saudi Arabia and Israel, and thereby set free substantial resources as well as manpower for the pursuit of peaceful purposes. Especially Egypt, which among Arabic countries has travelled furthest toward an industrial "take off", would greatly benefit from a definite cease-fire. Second, present obstacles impeding the setting up of a multilateral aid organization for the region could be easily surmounted, since the need for close economic cooperation between neighbours would become paramount. As noted before, economic aid allocated on the basis of regional plans rather than political affinities, would ensure optimal use of capital and know-how. Third, recognition of Israel by its Arabic neighbours as a legitimate trade partner would greatly stimulate trade within the whole region, for the economic structure of Israel, with its emphasis on more sophisticated capital goods, seems highly complementary to that of its immediate neighbours. It seems hardly necessary to add that the intensification of intra-regional trade is an excellent method to further economic growth in a large developing area.

The present oil bonanza in the Near East and North Africa offers great opportunities as well as grave dangers. If it is utilized in an endeavour to bring peace and prosperity to the whole area, it may well mark a turning point in the history of its ancient peoples; if it squandered on the procurement of more and better arms and on the financing of more and greater wars, it may bring about the destruction of all its inhabitants.

NET RECEIPT OF INDIVIDUAL DEVELOPING COUNTRIES AND TERRITORIES,  
"ODA" FROM DAC COUNTRIES AND RECEIPTS FROM MULTILATERAL AGENCIES

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1969 - 1971 (ANNUAL AVERAGES)

Country	Bilateral	Multi-lateral	Total	Per capita receipts
	Mio \$	Mio \$	Mio \$	\$
1) Kuwait	0,04	- 2,91	- 2,87	- 4,37
2) Qatar	..	0,00	..	..
3) Lebanon	4,23	7,19	11,42	4,32
4) Bahrein	0,23	0,04	0,27	1,27
5) Saudi Arabia	0,20	1,12	1,32	0,18
6) Oman	0,49	0,01	0,50	2,44
7) Iraq	- 0,02	8,48	8,46	0,90
8) Algeria	109,69	6,33	116,02	8,69
9) Tunisia	97,52	23,72	121,24	24,65
10) Syria	1,67	15,28	16,95	2,89
11) Morocco	88,31	16,25	104,56	6,95
12) Jordan	28,28	31,30	59,58	26,57
13) Egypt	15,29	11,39	26,68	0,82
14) Sudan	0,21	10,94	11,15	0,73
15) Yemen (P.D.R.)	1,51	1,88	3,39	2,78
16) Yemen (A.R.)	5,87	2,54	8,41	1,51
17) Israel	62,74	0,10	62,84	22,27
	416,26	133,66	549,92	

Source: OECD, 1972 Review, Development-Cooperation

"ODA" = OFFICIAL DEVELOPMENT ASSISTANCE



G N P per head of the Arab states and Israel

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1971

Country	Population (in 1000)	GNP at market prices	
		in mill. US\$	per head (US\$)
1) Kuwait	830	3,200	3,860
2) Qatar	127	300	2,370
3) Lebanon	2,804	1,840	660
4) Bahrein	216	140	640
5) Saudi Arabia	7,487	4,010	540
6) Oman	600	270	450
7) Iraq	9,750	3,560	370
8) Algeria	14,438	5,260	360
9) Tunisia	5,245	1,670	320
10) Syria	6,509	1,090	290
11) Morocco	15,379	4,040	260
12) Jordan	2,380	620	260
13) Egypt	34,080	7,540	220
14) Sudan	16,135	1,900	120
15) Yemen (P.D.R.)	1,470	170	120
16) Yemen (A.R.)	5,900	480	90
17) Israel	3,010	6,600	2,190

Source: Weltbank Atlas 1973

J. P. Perry Robinson (U.K.)

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ASSIMILATION AS A FACTOR IN ARMAMENTS PROLIFERATION

The example of CB weapons, and its relevance to the  
present disarmament negotiations

The joint US-Soviet communiqué from Moscow dated 3 July, 1974, contains the following passage:

Both sides reaffirmed their interest in an effective international agreement which would exclude from the arsenals of states such dangerous instruments of mass destruction as chemical weapons. Desiring to contribute to early progress in this direction, the USA and the USSR agreed to consider a joint initiative in the Conference of the Committee on Disarmament with respect to the conclusion, as a first step, of an international convention dealing with the most dangerous, lethal means of chemical warfare.

The reference to a "joint initiative" in the CCD might possibly be interpreted as a step forward when set against the corresponding passage in the US-Soviet communiqué of 25 June 1973:

Considering the important role which an effective international agreement with respect to chemical weapons would play, the two sides agreed to continue their efforts to conclude such an agreement in cooperation with other countries.

But in fact the grounds for optimism are not strong. It is disturbing to learn, for example, of superpower agreement on a stepwise approach to the problem--on confining the "first step" to "the most dangerous, lethal" chemicals. And then there is the fact that the decision to go for any sort of chemical treaty was (and probably still is) still pending in Washington, whatever the communiqué may have suggested to the contrary. To the extent that the consequence of this may be an undercutting of the US Defense Department's stance in the National Security Council's consideration of the matter, there are grounds for optimism; but to the extent that the communiqué may be public-relations rhetoric substituting for any real superpower interest in multilateral armaments limitation, there are also grounds for pessimism.

The fact of the matter is that, when the National Security Council review of chemical-weapons policy got under way earlier this year, the odds were heavily weighted against a policy outcome that favoured any immediate, significant step further towards chemical disarmament. The best that could be hoped for was a decision against foreclosure on the disarmament option and against endorsement of the Army's plans to embark upon a new round of chemical-weapons buying. This would allow time, hopefully, for the pro-disarmament faction in Washington, such as it is, to increase its strength, and for the Socialist countries in the CCD to formulate a more defensible position on the question of international verification. All in all, therefore, the prospects for rapid progress on chemicals at the CCD do not look bright.

Against this background it is useful to consider the long-term implications of a failure to reach agreement on chemicals, and--the opposite side of the same coin--the goals that should be established as the long-term objectives of a chemical disarmament agreement.

Elsewhere,<sup>1/</sup> I have argued that the primary function of a chemical agreement should be to constrain proliferation, because it is in the possibility of proliferation that nerve gas presents its gravest threat to international security, a threat which could greatly exceed that which is thought to exist in those few areas of the world where nerve-gas weapons are at present deployed. In a paper I submitted to the Pugwash CW Workshop in Helsinki this year,<sup>2/</sup> I explored certain of the conceivable determinants of chemical proliferation; for the present paper, I have sought to define and analyse one of these determinants more closely, namely the process of assimilation.<sup>3/</sup>

#### THE CONCEPT OF ASSIMILATION

Many, very different, modes of combat come within the category of chemical/biological warfare (CBW). Its scope is large because toxic and infective agents have potential applications throughout the entire spectrum of armed conflict--from the global war at one end to the sabotage or terrorist activities of dissident groups at the other. Yet the same is true for most other agents of warfare at the disposal of armed forces--explosives, bullets, flame, &c. And just as these are likely to be used in conjunction with one another, so also are CBW agents unlikely to be used in isolation from them. One may therefore ask, as many CBW professionals have done, what justification there is for making a special category out of CBW, and of treating CBW as a special case in disarmament negotiations.

The justification is to be found in the attitude of the military themselves. There do not appear to be any countries whose military do not treat CBW as a more or less special case. To varying degrees around the world, CBW has its own separate organisations, institutions, logistical procedures, training programmes, and so forth. In few, if any, countries can these be said to be fully integrated into their background. Where CBW instruction is included in the basic curriculum of recruits, the training is rarely extensive and is generally limited to the elements of protective countermeasures. In the very few countries where offensive CBW training is given, it is for the most part limited to special cadres. CBW thus lies outside the mainstream of military theory and practice. Military interest, as regards armaments, has always centred on explosives, projectiles, and other means of physical destruction. Until such time as the principles and technology of CBW have become more fully assimilated, CB weapons will remain 'unconventional'. The process of assimilation is the process whereby novel, 'unconventional' weapons become accepted as 'conventional' weapons.

Isolated as they are within a distinctly outcast category, CB weapons have acquired an array of moral and legal proscriptions that is unique among present-day armaments. This, however, is something with which most novel weapon technologies of the past have had to contend. Users of the cross-bow, for example, in Twelfth Century Europe risked excommunication by the Church; and

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<sup>1/</sup> Prepared statement to the Subcommittee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs, US House of Representatives, 2 May 1974. (The hearings of the Subcommittee have since been published under the title U.S. Chemical Warfare Policy.)

<sup>2/</sup> 'Binary nerve gas weapons: their economic, environmental and security implications for the United States, including their likely effects on the international chemical disarmament negotiations', February 1974. See especially pages 39-42.

<sup>3/</sup> This paper draws from earlier published work of mine, in Volumes I, II and V of The Problem of Chemical and Biological Warfare (SIPRI, 1971-73) and 'CBW: an introduction and bibliography' in Political Issues Series (Center for the Study of Armament and Disarmament, Los Angeles) vol.3 no.2, March 1974.

gunpowder went through a long period of moral opprobrium before becoming assimilated. People eventually became accustomed to these developments, and the weapons became conventional. Incendiary weapons provide a further example: witness the obloquy that fastened upon the recorded users of Greek Fire in medieval Europe, or General Beauregarde's expressions of moral outrage during the American Civil War, or the special attention given to flamethrowers in the League of Nations disarmament deliberations, and then the increasing conventionalisation of napalm and other incendiaries during the Spanish Civil War, World War II, the Korean War and Viet-Nam.

CB weapons have been in sporadic use for at least three thousand years, so what is it that has impeded their assimilation? References to them--few and far between, it must be said--occur throughout the recorded history and literature of many civilisations, including the Epic and Vedic Indian, the Hellenic, the Roman, the Byzantine, the Sung Chinese, and that of medieval and renaissance Europe. The information available does not permit an assessment of the military significance of these early instances; but it seems reasonable to suppose that CBW could not compete seriously with other forms of warfare until the prevailing accomplishments of technology had reached an advanced level. The efficacious use of CBW agents under combat conditions is not easy, and requires rather sophisticated equipments. Advancing further with this hypothesis, one may identify the point at which CBW acquired importance with the great influx of natural science and scientists into the military world at the time of World War I. It is certainly the case that much of present-day CBW theory derives from the practical experience of chemical warfare during that war.

The French were the first to use chemical weapons during the war, but it was Germany that made the crucial technical innovation. She alone among the belligerents, at the outbreak of hostilities, had access to the necessary technology (in particular, an industrial capacity for large-scale liquefaction of chlorine gas). She turned to it in 1915 as a possible way out of the trench warfare stranglehold and in the face of an acute shortage of the nitrates needed for explosives-manufacture. The other major belligerents soon caught up with her, however, and by the end of the war had far exceeded the scale on which Germany was capable of conducting chemical warfare. There were in all between one and two million CW casualties.

There are three principal ways of securing battlefield casualties with CBW agents. Liquefied chlorine gas, and its subsequent developments, enabled one of these three to be exploited on a scale that had never before been approached with any of them. The earliest recorded CB weapons worked either by parenteral injection, as in the case of poisoned arrows, or through contamination of food or drink. In the third method, that of bulk dissemination, the agent is used to pollute the air breathed by the enemy or to contaminate the ground over which he moves, thus creating a hazard to the skin. Cylinders of liquid chlorine, releasing a dense cloud of the gas when they are opened, permitted an unprecedentedly high level of toxic air pollution, one which could be localised with a fair degree of precision over enemy positions. Much, of course, depended upon the prevailing weather conditions, particularly wind direction, but as artillery techniques developed, so also did the possibilities of using agent-filled projectiles to compensate for unfavourable weather.

Bulk dissemination remains the most important of the three offensive CBW techniques. The other two are limited essentially to sabotage and assassination, although recent technological advances may have broadened the applications of the parenteral one (notably the possibilities for using deliberately contaminated shrapnel or multiple-fléchette munitions, as in the DIACBA development programme of the US Army). From an operational point of view,

however, there are many practical difficulties and unpredictabilities associated with bulk dissemination. These speedily became apparent during World War I and they persist to the present day, despite intensive endeavours in the weapons laboratories to mitigate them. They constitute one of the major discouragements of CBW, and may be identified as a principal constraint on the fuller assimilation of CB weapons.

#### THE TECHNOLOGICAL CONSTRAINT ON ASSIMILATION

The constraint noted above is essentially a technological one, and therefore sensitive to technological progress. It has several components. One has been alluded to already, namely weather-dependence. Quite a small change in weather conditions can necessitate a ten- or even a hundred-fold increase in the number of CB munitions needed for a particular mission--or, conversely, may vastly increase the hazard downwind of the target-area, thereby endangering friendly personnel or noncombatants even in the distant neighbourhood. The allowances that must be made for this will gravely complicate logistical and operational planning.

A second element in the constraint arises from the protective countermeasures that are available against bulk dissemination: respirators, protective clothing, automatic alarms, and so forth. Modern versions of these are capable of providing a rather high level of defence against CBW attack. The significant point, however, is not that protection is available, but rather that, under combat conditions, there will be great uncertainty, first, about how well the enemy is in fact protected; second, about the extent to which that protection impairs his overall fighting efficiency; and, third, about the degree to which the stresses and strains of combat will have opened gaps in the protection. Damage, haste and poor discipline will inevitably combine to make even the best-prepared defensive posture vulnerable to a CBW attack that is sufficiently heavy; but the attacker will not be able to predict his results with any confidence. The one exception to this is, of course, in the case where the enemy is known to lack any form of protective capacity whatsoever; and it is a significant fact that all the major instances of antipersonnel CW since World War I--in Ethiopia during 1935-36, in China during 1937-45, in the Yemen during 1963-67, and in Indo-China since 1964--were initiated against an enemy incapable of deploying antichemical protection.

A third element in the technological constraint is time-dependence. With the sole exception of the sensory irritants, no CBW agent produces an immediate effect. In addition, CBW agents can remain active and dangerous in the environment for a period of anything between minutes and years. Although military attractions may reside in this for certain specialised types of operation, the complexities which it will introduce into forward planning may be very great. Its consequence is that the effects of CB weapons are poorly controllable, not only in space, but also in time.

The importance of the technical factors outlined above cannot be overemphasised, for it is on them that the likelihood of future CBW critically depends. The technological constraint, in conjunction with the psychological one noted later in this paper, provides a plausible explanation for the humble status of CBW in military circles today. But both constraints are vulnerable to change. It is possible to envisage a weakening of the inhibitions about CBW and a concentration of technological resources into the development of CB weapons that are militarily and politically more amenable than those available at present. This is what has been happening over the past thirty years in the case of napalm and other incendiary weapons.

## INCENTIVES FOR ASSIMILATION

The incentives that might promote the assimilation of CB weapons can also be categorized as technological and psychological. As regards the latter, CB weapons are preëminently weapons of terror. Man's fear of poison and disease appears, on historical evidence alone, to be extremely deep-rooted, so that exposure to CBW agents, or the threat of exposure, may elicit very powerful responses. A potential user of CB weapons might well suppose that these responses would act in his favour. He might even value them as an instrument of strategic blackmail or deterrence. The notion of CB weapons as 'the poor man's atom bomb', particularly biological weapons, has been around for many years.

The technological incentives remain much as they were during World War I, with certain additions. Bulk dissemination of CBW agents provides a means for attacking large area targets; and airborne CBW agents can penetrate into spaces protected against physical attack. These are factors of some moment today, for the great weight of tactical firepower--nuclear and non-nuclear--now available has imposed doctrines of dispersed deployment in which ground forces are scattered over wide areas. On a weight-for-weight comparison, CBW agents could be considerably more potent than almost all military casualty agents, even fissionable materials, thus suggesting a role in compensating for quantitative manpower inferiorities. The 'biospecific' character of CB weapons, namely their capacity for leaving inanimate objects largely intact, has certain obvious attractions, both at a tactical and at a strategic level. And the recent emergence of 'incapacitating' CBW agents, ones that cause predominantly nonfatal battle casualties, could provide a means for lessening some of the political costs of using armed force--a consideration which, on the civil front, leads police forces to use tear gas. The development of antiplant and, to a lesser extent, anti-animal CB weapons has added a further dimension.

## THE PSYCHOLOGICAL CONSTRAINT ON ASSIMILATION

It is conceivable that if rigorous analyses were made of all the technological constraints and incentives that would govern resort to CBW in particular war scenarios, with full regard paid to the capabilities of existing CBW technology, offensive and defensive, the balance of judgement might, in some scenarios, favour use of CB weapons. This is certainly something which the advocates of CB weapons have long claimed, not least before US Congressional appropriations committees. The details of the analyses have, however, usually been shielded from general scrutiny by security-clearance requirements. If, nonetheless, it is assumed that the analyses have been adequately founded and their conclusions reasonable, the question still remains as to why past advocacies of CB weapons have not been more successful. What other reasons are there for the relatively low level of military interest in CBW, and could they change with time?

The factors that seem to be at work here may be thought of as the 'psychological' constraint referred to earlier. Whether in fact a psychological explanation for them is to be preferred over, say, a behavioural or a sociological one is a matter for further study. The constraint has had its most obvious expression in, first, the attitude that still seems to be widespread in military circles that CBW is in some way dishonourable, impugning military codes of professional behaviour, and, second, in the legal proscriptions that are associated with CBW. Since its earliest days, the use of CB weapons has been considered peculiarly reprehensible, a view that was embodied in Roman and in Islamic law, and which is retained in a more explicit form in the modern international law of armed conflict. The central element in the present-day legal proscription is the

1925 Geneva Protocol, an international treaty to which most States are parties, albeit still with the important exception of the United States (largely at whose instigation, however, the Protocol came into being). The Protocol outlaws use of CB weapons, but has nothing to say about their possession.

International law is closely bound up with public opinion, which it serves both to define and to direct. When opinion changes the law begins to weaken, but opinion on CBW seems to be as hostile as ever, despite recurrent attempts at modifying it. In the short term, these attempts have sometimes succeeded (as when the US Army Chemical Warfare Service succeeded in blocking US ratification of the Geneva Protocol in 1926), but opinion on CBW has always tended to revert to its former state. Considered on purely logical grounds, there is no convincing reason why CBW should be regarded as any less acceptable, or more acceptable, than other forms of warfare. There is undoubtedly an element of paradox in the degree of attention it has received from jurists. To say this is not to call into question their wisdom; rather, the irrationality of the situation, and its persistence in the face of 'rationalising' attempts by CBW advocates, indicates the strength of the underlying psychological and sociological factors.

#### ASSIMILATION AND THE LAW OF ARMED CONFLICT

The record of international law in restraining wartime behaviour is not impressive; the law has more often been the servant, not the master, of military expediency. In the case of CBW, however, the relevant law will remain a substantial restraint at least for as long as the appurtenances of CBW remain poorly assimilated by the military. More important, the law constitutes an obstacle against further assimilation.

Conversely, erosion of the law on CBW will facilitate assimilation. That is why the present controversy regarding the legal status of herbicides and irritant agents, such as CS and the tear gases, is so important. Largely as a result of their employment by US and allied forces in Indo-China, and subsequently by their adversaries, CS weapons are now the furthest advanced towards assimilation of all CB weapons. But the Vietnam-related efforts to reduce, through R&D, the technical and operational limitations of CS weapons, and to increase their military utility and attractions for regular combat forces, has inevitably meant a weakening of at least the technological constraint on the assimilation of all types of CB weapon. This, it should be noted, was by no means an unintended consequence of the use of CS--and herbicides as well--in Viet-Nam. During a recent interview, the senior US Army chemical officer of the time was utterly explicit on this point: the Viet-Nam war provided a much-needed opportunity for him to demonstrate the value of his wares to the Army at large, and for the Chemical Corps to secure that combat role which would enhance its status and protect it from bureaucratic repression in Washington. CS employment, chemical crop-destruction and chemical defoliation were only three of many CBW proposals put forward by the Chemical Corps for the Viet-Nam war.

The Geneva Protocol is the strongest available bastion against this particular process of assimilation. It is therefore to be hoped most fervently that, when the US National Security Council comes to consider the new interagency study that has just been completed on the question of US ratification, it will rescind the present US "understanding" that the Protocol does not cover herbicides and irritant agents.

There is another locus of potential erosion. Since 1970, it has been the British Government's position that, although tear gases are covered by the Protocol, "CS and other such gases" are not. The decision to adopt this

bizarre interpretation arose out of the exigencies of the situation in Northern Ireland (where CS weapons were being used), even though the Protocol is not applicable there. But since last year, the British Army has been stockpiling weapons based on the newer, and more potent, agent CR (dibenz[b,f][1,4]oxazepine). The effects of CR are much longer-lasting than those of CS, and fall within the current US definition of an incapacitating agent. Whatever the present US position may be on CS, it does at least foreswear the first use in war of incapacitating agents. Yet, because in the British Defence Ministry's view CR is evidently subsumed within "CS and other such gases", the British Government is apparently reserving the right, unless it withdraws its 1970 interpretation of the Protocol, to use incapacitating agents in war, as well as CS.

#### ASSIMILATION AND CB DISARMAMENT

In 1972, after nearly four years of talks on CBW at the ENDC/CCD, the Biological Weapons Convention was opened for signature. It contains a commitment to negotiate further, and in "good faith", for the elimination of chemical weapons. The fact that biological weapons were separated out from the CB weapons category can be understood in terms of assimilation. The practice of BW is technologically more demanding than that of CW, and psychologically more disquieting. BW agents have characteristics which are difficult to harness for offensive purposes, and which do not fit at all easily into military practice. In the case of the United States, biological weapons were the subject of an R&D programme which became quite intense during the early 1960s; but, even so, no one device ever passed through acceptance trials by the US Air Force, the potential user Service for whom they were least unsuited. The weapons seem to have come up against major technical problems which there was no great incentive to have solved. The recently-destroyed stockpile of BW agents, and the production facilities for them, were in support, less of a military capability, than of a development programme that had become moribund. Chemical weapons, in contrast, were less poorly assimilated, and the United States (and maybe other countries too) is not yet willing to forego their possession.

The suggestion here is that it is the extent to which a particular class of weapon has become assimilated which determines the prospects for its elimination via a partial disarmament agreement. The agreements on collateral measures which have been concluded so far would seem to bear this out, for they are directed against activities which the military has no particular wish to indulge in. Dispiriting though this conclusion may be, it has a practical corollary: the long-term stability of a disarmament agreement will be determined by the extent to which it brings under control the pressures towards further assimilation.

Research and development activities are an obvious source of pressure in the case of chemical weapons. There are two particular areas of concern, neither of which have yet received the attention they deserve from the CCD.

The first is that of incapacitating agent research, because it is these agents that most threaten the psychological constraint on assimilation. Until rather recently the problem did not seem to have all that much urgency, largely because of the difficulties which the R&D teams concerned were likely to have in coming up with a militarily attractive agent. The importance which the US Army attached in the early 1960s to the psychochemicals SN and BZ was soon shown to be unfounded; and the inclusion of toxins within the Presidential BW renunciations of 1969/70 precluded the further development of PG. But it now seems that the US Army has found a new and more attractive candidate, a percutaneously-active anticholinergic glycollate code-named EA 3834. This new



psychochemical, and munitions for it, are now in the terminal stages of development.

The second area of concern is that of CW protection R&D. Since it is unlikely, and probably undesirable, that a chemical agreement could ever be negotiated that proscribed antichemical countermeasures, the supporting R&D will presumably continue. Yet it is precisely from this type of work that several of the major developments in offensive CW techniques have in the past originated.

#### ASSIMILATION AND MILITARY DOCTRINE

Since use of chemical weapons is illegal, their continued stockpiling seems to imply a scant regard for the provisions of international law. But the laws of war derive what strength they have from the sanction of reprisal, so that as a retaliatory capability the stockpiles can be given a sort of justification. The fact that they are also available for initiation of CW, law or no law, is no doubt seen as an advantage by those who value a wide range of military options; it is seen as a disadvantage, and a reason for pursuing chemical disarmament, by those who see in this ambivalence a source of international mistrust and tension.

Clearly there are parallels to be drawn here with nuclear weapons, but they should not be taken too far. States that possess nuclear weapons have by now been forced to condition themselves into at least some degree of readiness to use the weapons. So, with greater or lesser reluctance, nuclear weapons have been accepted into military doctrine and the doctrine has been modified to accommodate them. Such is not yet the case with CB weapons. There is a school of thought among strategists which holds that CBW has an important role to play as an intermediate rung on the ladder of escalation, providing a firebreak option between conventional and nuclear war. But this is a precarious rationale, for the more rungs there are, the easier will the ladder be to climb. Current British policy, for example, appears to envisage nuclear retaliation against CBW attack.

What also has to be kept in mind is the strong element of ex post facto rationalisation that runs through much of military policy-making, both nuclear and non-nuclear. One of the effects of mobilising science and technology in the service of national defence is that new weapons tend to appear before there is any obvious requirement for them. The technologies concerned have a momentum of their own, and so long as a thriving military technology is valued as an element of national security, military policy and doctrine must be elastic enough to accommodate it. This does not seem to have been an easy task in the case of CB weapons technology, which, at least in the United States, has long been outstripping military requirements; and the military authorities concerned, as distinct from the CBW advocates, have so far shown little enthusiasm for attempting it. When they have been forced to articulate a reasoned CB weapons policy, the doctrine of like-with-like deterrence has, for all its obvious shortcomings, been put forward. Time could well bring with it a very different attitude, if CB disarmament does not come about first. It is entirely conceivable that the march of progress within the R&D laboratories, and a loosening of the inhibitions about CBW, could promote that wider assimilation of CB weapons which would be the essential prerequisite.

JPPR, 16 August 1974  
Berliner Projektverbund der  
Berghof-Stiftung für Konfliktforschung,  
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THE PROPOSED THRESHOLD TEST BAN TREATY -- A STEP  
BACKWARDS FOR ARMS CONTROL

At the Moscow summit meeting in June 1974 the United States and the Soviet Union announced their intention to conclude a new threshold agreement that would limit underground testing of nuclear weapons to yields of not over 150 kilotons. A significant component of this agreement, and one which has been insufficiently publicized, will be a provision to spell out procedures for the expanded use for peaceful purposes of nuclear explosives, which might have even larger yields than 150 KT. In 1963 when, because the two nations could not agree to ban all nuclear explosions, they were led to agree on a limited test ban treaty (LTB), the addition of a threshold on underground tests would have been welcomed.

In 1974, a decade later, the world has a right to expect more. Given the very extensive nuclear testing by both the U.S.S.R. and U.S. and the immense stockpiles of varied nuclear weapons which both now have, the military gains from still further testing will be insignificant. The problem of discrimination between underground nuclear explosions and earthquakes, which was the ostensible difficulty in negotiating a comprehensive test ban in 1963, now seems much less consequential. Furthermore, the considerable improvements in long distance seismic detection and identification have increased national capabilities for discrimination between explosions and earthquakes to the point where on-site inspection,

the former bugaboo, no longer seems technically significant. The unwillingness of the U.S. and the U.S.S.R. to propose a treaty to ban all nuclear tests must be viewed as a signal from the two nations that, despite world opinion, they are not really interested in stopping all tests of nuclear bombs.

Setting the threshold for the proposed new treaty as high as 150 KT is particularly unhappy. It will permit the U.S.S.R. and the U.S. to continue nuclear weapons test programs not significantly different from those they have pursued in recent years. Nor will the threshold agreement be more useful than the present Limited Test Ban Treaty in restraining the development of nuclear explosives capability by non-nuclear powers. For example, the recent nuclear explosion test by India was only about 15 KT. To add insult to injury, even the 150 KT threshold is not scheduled to become operative for almost two years. Finally, the impact of the proposed agreement on the Non-Proliferation Treaty will almost surely be negative. The non-nuclear states will view this new proposal as a sham, hardly consistent with Article 6 of the NPT wherein the parties undertake "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race..."

Of particular concern is the projected U.S./U.S.S.R. agreement for nuclear explosions for peaceful purposes which will presumably permit explosions above the 150 KT threshold and which is to be agreed on by the two nations in advance of submission of the threshold test ban. Skeptical non-nuclear nations will see this as another avenue for big power weapons tests especially if the arrange-

ments do permit "peaceful" explosions of larger than 150 KT. Furthermore, if earthmoving nuclear explosions are contemplated, as seems probable, they will almost certainly produce sufficient radioactive debris to cause it to be present outside the territorial limits of the nation of origin, which is prohibited by the Limited Test Ban Treaty of 1963. The consequent weakening of the LTB would be a seriously regressive step.

These defects persuade us that the proposed threshold agreement with its peaceful explosives agreements will be a step backward in arms control. We strongly hope that the U.S.S.R. and the U.S. will reconsider these unfortunate proposals and that serious negotiations will be promptly resumed on what the world really wants and needs, a treaty for a comprehensive nuclear test ban.

EUROPEAN SECURITY AND CO-OPERATION :  
CONCEPT AND PERSPECTIVE

A positive fact of our epoch is the increasing effort of a growing number of states and nations to establish a system of relationships which will enable every nation to develop harmoniously, promoting at the same time peaceful and friendly co-operation in a climate of détente and mutual understanding.

In this tremendous effort one can see that the peoples of the European continent have learned by experience, as recent and not too remote history clearly showed.

Europe, a continent of unbridled cultural development and advanced civilization has contributed in very large measure to progress of mankind; the material and spiritual treasures of our continent are testimony to the unlimited possibilities of its nations' creative genius. But, unfortunately, in the course of history, and particularly in our century, this continent has been stirred by violent conflicts leading to two World Wars, producing incalculable losses, material and spiritual. At the same time, the objective reality has proven that, although the existing potentials of the nations of our continent are the same, the impact of national and social factors have differentially influenced their levels of economic and social development. Using as an index per capita national income, the international statistics show that, in Europe, the relation between highly developed countries and less developed countries, from the economic point of view, is represented by a ratio of 5 or 6 to 1. It is a positive fact that, since the Second World War, several nations whose development level had been lagging behind, are succeeding in reaching, by their own tremendous effort, an economic and social development which will constantly reduce the huge gap left from the past.

It is a well known fact that Romania - a country with an old culture, with a hardworking and gifted people, and following the road of socialism, has recorded remarkable successes in its social and economic development, while abolishing any form of exploitation. Within a short historical period, this underdeveloped country, with its backward industry and primitive agriculture, has become a highly industrialized country, possessing a modern, mechanized agriculture, a country whose science and culture has asserted itself not only at the national level, but

also in the world arena.

Thus, those industrial fields which are decisive for economic progress have experienced great development - e.g. the machine industry, electro-technics, electronics, the chemical industry, siderurgy, and so on. After the nationalization of the means of production, the level of industrial production recorded a 14.3% rate of growth yearly; and in 1973 it grew by 14.7% over the 1972 figure.

The extension of technical progress in agriculture has been given a great impetus, and the rate of growth of agricultural production thus increased from 2.7% during the 1956-1960 period to 6.8% in 1973.

Together with industrial and agricultural development, education, science and culture have made great progress. Education was developed in towns as well as in villages, and new relationships were created in social life and in practical activities related to the needs of societal development. Secondary school education has been made universal beginning with 1974. In this way, Romania has become a country on the way to full economic, industrial and social development.

In the context of the wishes of the nations of Europe for a better life and for international détente, action has been taken, which is destined to create on our continent a system of relationships between states giving each one assurance that it can develop free from any danger, that its development is to be harmoniously and peacefully co-ordinated with the development of other nations. This is what one calls security, collaboration and co-operation among the nations of our continent.

Taking a retrospective look at historical events, it can be ascertained that it has not been long since the concept of security was connected, in some way or another, to relationships of domination and exploitation. Thus, it was considered that a small country - from the point of view of its number of inhabitants and of its area, or a less developed country, must depend, from the political, economic and social point of view, upon a great country, a powerful and more developed country, a country which could protect it, that is, could offer it "guarantees" of security for its continual existence. However, experience, unfortunately tragic, has proven that these systems were not only inequitable but also non-viable, since the small countries were always backward countries and their economic and

social development was subordinated to the interests of the great powers. There was, therefore, a continuous economic and intellectual exploitation, with their natural resources used by and for the benefit of these great powers. History has refuted such guarantees, or systems of guarantees, since in practice they never deterred any intervention, whether armed or not, or prevented modifications and annexations of territories or direct interference in the internal affairs of other states. On the positive side, these experiences led to the development of national consciousness and of concepts, now happily almost universally accepted, concerning the equal role of every nation in establishing a climate of détente and international co-operation on our continent. These concepts, which are the foundation of the current European Security and Co-operation Conference, are based on the principle that, after all, security is a matter which involves every nation equally, small or great, more or less developed. Indeed, history has proven that, during the great tragic conflicts of the not too remote past, sufferings and losses affected almost all states equally, and that, therefore, security cannot be considered separate from the international context. Furthermore, security is linked to the concept of mutual respect and equality among all nations of our continent. The existence of disparities in economic, industrial and social development and of differences in military potential, cannot and must not constitute a differentiating factor between security and development. After all, the human capacity of the countries to produce material and spiritual goods is not different, and the existing differences in levels of development is not the consequence of their own efforts, but the result of their forms of government and of their systems of exploitation and oppression. These differences have always represented a factor promoting insecurity and instability. The equality of all states, small and great, as a basic concept, implies a whole succession of concepts destined to contribute to the establishment of universally desired security and collaboration. Thus, non-interference in internal affairs implies that every state must have the inalienable right to choose the path toward the system of economic and social development which it considers to be the best. This means that in a real security climate no influence should be exerted in order to change an existing political, economic and social system.

The concept of non-interference in internal affairs is linked to the concept of respect for independence and international sovereignty and the concept of

territorial integrity (the system of boundaries). National sovereignty and independence represent, in fact, the inviolable right of every nation to be master of its own territory and of the goods existing within it. History has proven that the dependence of a small nation on a great one has always been a breeding ground for interference, for disagreements and conflicts. Aware of the necessity for peaceful co-operation, nations have understood this concept as indispensable to real progress.

There are states with different social-political systems on the European continent, among which the socialist system must be particularly considered. This does not mean that nations, convinced by their own experience of the superiority of their own system, can try to influence the existing systems in other countries. Even within the framework of the socialist system, based on the abolition of human exploitation, a system in which people become the only owner and beneficiary of all natural, material and spiritual goods, using them to promote their prosperity, different ways and means of implementing the strategy and progress of development can be followed, taking into account the specific features of each nation, the present level of its development, its customs and traditions. This does not mean that the development of every nation must be carried out in an insular way. As in every human society, every nation learns and borrows from the experience of other nations what it considers useful for itself, and, in its turn, every nation imparts its own knowledge and the fruits of its own creative activity. Therefore, collaboration and co-operation are the first conditions for a security system and for mutual understanding on the continent.

The military aspects of security must include, as partial measures for disengagement and disarmament, the withdrawal of military troops, existing on foreign territories, to within their own national boundaries, the closing of all military bases and at the same time the corresponding reduction and elimination of troops, so that these bases no longer constitute a threat to other states, and finally the abolition of the military blocs. The central pivot of stability and of respect for the new relationships in Europe, as well as of the underlying premises of development and co-operation, is the concept, imposed by the requirements of reality and the examples of history that, under no circumstance, should force or the threat of force be used in international relations, that all conflicts or disagreements must be resolved only by negotiations, by peaceful discussions among the interested parties.



The existence of a military potential and armaments - certainly different from country to country - have always been important breeding ground for conflicts, insecurity and instability in Europe. It is obvious that increasing military power implies increasing military budgets, whose consequences are a heavy burden on the nations of Europe, and which hamper the use of these important investments for national progress and development. On the other hand, as is well-known, this military potential can never be considered as a stable one, because every nation tries continually to amplify and improve it, thus giving rise to the so called "arms race".

Statistics prove that, although the whole world has made tremendous efforts to reduce military weapons and power, military budgets have been continually growing, e.g. the USA in 1949 about \$13.5 billion and in 1973 about \$78.5 billion. It is unnecessary to prove that the existence of such military power - particularly the weapons of mass destruction - are the major factors promoting insecurity, fear and disagreements among nations, and creating a climate which can lead, at any time, to a conflagration with tragic consequences.

Therefore, a concept of security and co-operation in Europe must be a concept of military disarmament, and primarily of nuclear disarmament. Theories, unfortunately still prevailing, which tend to show that disarmament can begin only if the two antagonistic military blocs have reached the same military potential, are not only non-viable, but also inhumane. On the other hand, experience has shown that no military power will ever wait until others reach the same level of military power. On the contrary, countries are engaged in a spiralling arms race. This tends to accelerate the growth of military budgets, and places an ever-increasing burden on people's shoulders, hampering their progress and development, not to speak of producing an ever-increasing international stress. Within this context, and essential to security, it is necessary to take real and effective measures to carry out that disarmament which is not only the wish of European nations, but also of all the nations of the world.

What are, in fact, the steps leading to the achievement of these concepts, steps which are not only realistic but humane as well, direct expressions of people's unanimous wish to live in peace, understanding and co-operation? One must, firstly, take into account the importance of the proceedings of the European Security and Co-operation Conference - the second stage of this conference is closing now

in Geneva. The conference's debates stressed a number of measures and procedures which will be effective if they are carried out.

In order to achieve the Conference's aim - and this is a unanimous wish - there must be established the elements of a process leading to a security system, conceived as an ensemble of clear and concrete rules and norms, the acceptance of which, as was mentioned above, must be in accordance with the principles and norms of the UN Charter. Every state must take these rules and norms into account and apply them in its relationships with other states, irrespective of their political or social systems. These rules must be based on new concepts which represent the wishes of people, not only on our continent, but as was mentioned above, throughout the entire world.

In Europe, the fact that co-operation and collaboration are components of European security (mentioned, as one can see, in the Conference's title), must constitute, in this context, a norm of conduct in the relationships among nations. These relationships must be based on equality of rights, mutual advantage, respect for the independence and sovereignty of every state, non-interference in internal affairs, refusal to use violence or threat of violence. The advantage of this system of collaboration and co-operation is the extension of the trading and economic relationships of all advanced countries, while the less advanced will have the possibility to accelerate their own development, reducing in this way the existing technological gap, which, as is well known, has always been a factor promoting insecurity and instability.

Collaboration and co-operation must be understood in their different meanings, scientific, economic, industrial, commercial, cultural, and at their different levels, between two or among several nations. It is known (and this represents an important element) that even the exchange of information can have a positive effect, promoting better understanding, doing away with certain prejudices and wrong ideas, that have prevailed for a long time. After all, human culture is a common component of the spiritual heritage of all peoples. It is well known that many countries have conducted intensive scientific researches, leading to important achievements in the field of human knowledge, but which have not yet been conveyed to mankind. In the context of collaboration and co-operation, all nations must benefit from these results, but of course only for their progress and welfare. One could mention, as an example, the researches in nuclear energy, which could be of

a great importance in the replacement of conventional energy resources. Another example of co-operation and collaboration is the lowering of artificially erected customs barriers, sometimes based on irrational reasons, which, since they interfere in other nations' internal affairs, are still an obstacle to détente, understanding and mutual respect. All such customs barriers must be abolished. The above shows that this Conference should establish means and principles able to create a human context for real collaboration and co-operation among nations. The Conference cannot solve, at once and for all time, the complex problems connected with security and co-operation; but it must, first of all, establish a clear and concrete context in which to discuss these problems. The end of this stage of the Conference is awaited by all nations who wish to attain the highest level of the Conference, the third stage. Here, the Conference must organize, with the participation of all nations, standing bodies charged with debating these problems, with determining details and new aspects, with setting forth new directions for action, and achieving in this way, for the first time in the history of this continent, efficient bodies which will secure détente and a peaceful climate.

The recent events in Cyprus have demonstrated eloquently (unfortunately through casualties and material losses) that if the basic principles and concepts of present security and international co-operation are not respected (viz. non-interference in internal affairs, sovereignty and independence, non-violence) there will be engendered only conflicts and dangers, in a word, insecurity. There is, therefore, an imperative and urgent need to close the Conference's proceedings and to put into effect its decisions.

Our conviction (and, I would say, the conviction of any scientist aware of his moral and social responsibility) is that there exist in Europe very many conditions for the establishment of a climate of security, co-operation and collaboration, so greatly desired by all nations, and which would positively influence the whole of international relations. Scientists, as the representatives of their peoples' aspirations, must relentlessly seek means of accelerating this process, must find methodologies and scientific analyses not only demonstrating its irreversibility and necessity, but also providing long-term or phased solutions which should be used by decision-making bodies.

This is the only way in which scientists (and I should like to mention particularly those who participate within the framework of the Pugwash Conferences) will be able to fulfill the moral mission entrusted to them by society.

EFFECTIVE MEASURES TOWARD GENERAL DISARMAMENT  
ESPECIALLY NUCLEAR DISARMAMENT

Firstly, I take the liberty of saying that I greatly appreciate the consistency and the responsibility shown by Pugwash Conferences in their activity, tackling each year the most important problems of mankind and its development, particularly problems concerning science. I appreciate their attachment to the noble role of science, which is to safeguard peace, to create a fruitful climate of trust and cooperation among nations, to achieve progress in civilization and the welfare of mankind.

The essential feature of our epoch is the increasing part played by public opinion and the broad masses of people in the evolution of world policy and the promotion of peace and cooperation. As a result of the increase in the political activity of the broad masses of people, of the ever stronger assertion of popular movement aiming for free development, we are witnessing deep social and national transformations, changes in the balance of forces and positive processes, leading to détente and collaboration.

An eloquent expression of this new tendency is the fact that during the last year, several problems which endangered peace and security were solved and also that negotiations and cooperation among states were strengthened.

We must remember, at the same time, that there are political forces maintaining the old policies of inequality, domination, aggression and war, policies which hamper peace, détente, cooperation and understanding. Democratic forces and peoples of the whole world must make an increasing effort to normalize the international climate.

The old international problem - disarmament - crops up again with indisputable force. Nowadays, public attention is focused on the disarmament problem, especially on nuclear disarmament, which worries the whole world. A real and concrete solution, awaited by the whole world, is delayed on the one hand by the exceptional growth of military expenditure, implying a continual improvement in weapons of mass destruction, and on the other by disarmament negotiations.

During the last decade, world military expenditure was \$2,000 billion (quoting World Armaments and Disarmament, SIPRI Yearbook 1974, The MIT Press, Cambridge, Massachusetts and London, England p.207). Last year, military expenditure attained a

record figure, over \$221 Billion, and if the growth rate remains steady, in 1980 this figure will be \$300-350 billion per annum. In other words, during our decade, the eighth of our century, mankind will be deprived of over \$2600 billion representing military expenditure.

These facts are a heavy burden on nations which in a military conflagration would pay a material and human price incomparably greater than that of the two World Wars; nations therefore have a right to know the level to which the arms race has evolved, to know what dangers threaten their life and their peaceful activity, so that they may safeguard their vital interests.

Protest and the expression of disapproval can be influential factors in the decision-making leading to general disarmament and particularly nuclear disarmament.

These figures are important and edifying, because they show the quantity of human and material resources consumed at the world level by this arms race, but each state and category is not mentioned individually within this arms race framework. One might think, therefore that there is general participation, but in fact the number of nations taking part in the arms race is limited. In their recent study entitled "Desarmament et developpement", the Polish authors Josef Pajestky Jery Zdanowie and Jan Kulig state that 85% of total world armament funds are spent by only nine countries - the five continuing members of the Security Council and the FGR, Poland, Italy and Canada - while the remainder, over 130 countries, spend only 15%.

This arms race continues while in international life violence and the threat of violence, conflicts and disagreements prevail even now; therefore many countries have to allocate part of their human and material resources to the assurance of their national defence.

In spite of the enormous military arsenals and of their great destructive capacity, one continually researches and experiments in order to find new weapons and improve old weapons, increasing their destructive force and their range, i. e. their efficiency.

The most valuable technological and scientific discoveries, as well as important financial and human potential, are used to this purpose. An eloquent example is the so-called "guided bomb" or the "clever bomb" which certain American authors consider the "greatest progress" in the weapons field since 1945.

Another recent and important area of military research is that of laser applications in guiding, telemetry, target finding, and in other fields such as plasma, antimaterial bomb, perfecting of the laser weapon etc.

Among the different specific manifestations of the arms race, an important one is that of the common military manoeuvres with the participation of troops and bases established

on foreign territories. Such a display of force has great political, military, strategic and economic implications throughout the whole world; the principle area concerned is the European continent and its adjoining zones, as well as other sore points of the planet.

An alarming figure is recorded for foreign military troops established on the territories of other states in Europe.

According to the estimates of certain international research institutes, there are almost one million soldiers established on foreign territories.

Linked to military troops on foreign territories there are the military bases forming a network system created and supported by the great powers in order to promote their political, strategic and other purposes. According to the estimates of the review "La Vie Internationale", the United States alone has, in different parts of the world, over 2000 bases and other military plants, over 300 of these being of significant dimensions.

The world arms race, particularly the nuclear arms race, is a source of increasing dangers for world security, and a huge unjustified waste of resources; a great source of danger in a world committed to the stabilization of the new effort toward detente; a huge waste of resources in a world committed to progress and development, but concerned by the lack of energy. Over \$200 billion yearly allocated to defence is a huge amount which, invested in productive fields, would propel development to its highest productive orbit.

Compared to this, the achievement of a programme aiming to double the agricultural production of 52 developing countries by 1985 would require about \$112 billion.

The National Bank's report states, in its financial exercises, that the credit allowed to member states was \$3.5 billion. In other words, the National Bank needs over 50 years in order to mobilize these investments for the development of member nations - that is, the equivalent of the financial resources spent by mankind in one year for armament purposes.

One does not need other examples in order to understand why the problem of the cessation of the arms race, and primarily nuclear disarmament, is a crucial problem in our epoch.

Arguments for the need to break this vicious circle, to stop this arms race and to take certain effective measures for the achievement of disarmament, are very clear and stable in the conscience of all nations.

The new course to detente and peace in the international life offers new premises favourable to disarmament; it is paradoxical that at the same time the arms race is growing in dimensions and intensity; it grows both "horizontally" and "vertically". Detente and peace obviously require the initiation of the disarmament process, the carrying out of certain practical and efficient measures designed to achieve disarmament, nuclear

disarmament in particular. Detente and armament cannot be included in the framework of the same process - they are mutually antagonistic. But the option was firmly and categorically expressed in favour of detente - therefore it must be carried out by disarmament measures. The new course toward detente and collaboration would be decisively strengthened by disarmament measures which could finally eliminate the possibility of the use or threat of violence and would reduce, and eventually eliminate, the risk of war. At the same time, such measures would strengthen trust and understanding among nations, and would increase the chances of political solutions. Political detente implies military detente.

In the second place, one cannot combine in the same process the arms race and the highest aspiration of mankind, development; they are also mutually antagonistic. It is a glaring truth that \$25 million spent in one hour for armament purposes deprives mankind of huge investment resources, which are withheld from productive areas and thrown in Danaides' barrel.

The only effective way in which Disarmament - Detente - Development can be achieved, the only coherent and rational equation, is to step from declarations and intentions toward actions, i. e. to take concrete measures for real disarmament. No doubt disarmament is the most complex, painful and difficult chapter of international reality. But this must not be considered an argument for the continuation of the arms race; on the contrary, it is a new and strong grounds for nations mobilizing their forces for the initiation of the disarmament process. "Arms race is difficult but necessary and possible"; a military Atlantic decision-maker recently argued for the need to continue the arms race. It seemed that the man was joking but a witticism gushes from the brain, and not from uranium. If the decision-maker's assertion suggests that someone should begin nuclear disarmament, it is clear that it should be those who possess nuclear weapons.

There are several reasons for concluding that there is an urgent need for those people aware of the danger of the arms race to increase their activity in order to persuade the decision-makers to take concrete measures for the cessation of the arms race. It is obvious to the whole world that if concrete agreements are not carried out, the nuclear arms race will persuade other states to find corresponding means for their weapons development, including nuclear weapons - these facts lead to a growing arms race.

It is imperative that concrete measures are taken, designed to achieve a real disarmament, to reduce military troops, to dissolve foreign military bases and blocs, to reduce arms budgets, so that these resources could be used for social and economic development, for the welfare of mankind, avoiding the danger of a new destructive war.

The UN Organization and other international bodies have the important role of solving these major problems of international relations and therefore the disarmament problem; within the framework of these organizations, states could work together for a

climate of detente and cooperation, in order to solve disagreements , in the interest of every nation and for peace in the world.

The complete and immediate annihilation of nuclear and other weapons of mass destruction is the most urgent need in the disarmament field. Our opinion is that disarmament negotiations must acquire a new and more active trend implying also the activity of the Disarmament Committee in Geneva, in order to pass on to general discussions and to adopt practical and efficient disarmament measures.

I consider that in order to promote detente, trust and cooperation among nations, it is of great importance that partial measures are achieved, such as the reduction and freezing of all military budgets, firm agreements not to use violence or the threat of violence, no interference under any circumstances in the internal affairs of other states, no new military bases or nuclear weapons on foreign territories, the removal of foreign military bases, the withdrawal of military troops to within national boundaries, the creation of nuclear-free zones in various parts of the world ; preparing in this way premises which will lead to the abolition of the military blocs.

An essential condition for the successful resolution of disarmament problems, the major international problems, is to respect the legal national interests in peace and security of all nations. No problem concerning a nation's life, regardless of its nature, can be solved only by certain states or by a group of states. All nations, regardless of population, of area, of the economic, technical, scientific, and military potential, have this right.

Therefore, we consider that based on adequate preparations, a Disarmament Conference should be convened, with the participation of all nations, which will tackle the major disarmament problems, primarily those concerning the prohibition and annihilation of nuclear and other weapons of mass destruction. I consider that it is necessary also to create an adequate context for the participation of all nations at the Committee debates in Geneva in order to activate the Disarmament Commission of the General Assembly, convening all member nations.

I want to express my firm conviction that those who serve science understand the fact that disarmament, especially nuclear disarmament, is a crucial problem in our epoch on which depends the development of every nation; its positive solution and the future of mankind depend on the efforts made by each and every one.



THE ROLE OF SCIENCE AND TECHNOLOGY IN NATIONAL DEVELOPMENT  
AND THE NEED FOR INTERNATIONAL CO-OPERATION : WAYS AND METHODS  
FOR THE DEVELOPING COUNTRIES TO BENEFIT BY ADVANCES IN SCIENCE  
AND TECHNOLOGY

To speak once again about the role of science and technology in modern society, particularly in front of an audience of the highest scientific qualifications, seems to be superfluous. Nevertheless, the international scientific community's debates concerning this topic do not come to an end - indeed, it seems that they are continually increasing. The explanation consists in several actual aspects which identified new links between science and man, science and society, science and nations. This paper does not try to give a full view of this topic; it is only a simple and modest attempt to point out some existing trends - or trends which should exist - in the world of scientific investigation, and to present the author's opinion about these trends.

In our epoch, the essential aim of science is to give free access to its achievement to every person and to all nations of our planet. Science was, still is, and ever will be an instrument of human society in its continuous effort to know, and to use in the best way possible, the natural environment to attain better self-understanding and for the improvement and prosperity of mankind. The entirety of historical evolution proves that social progress is strongly connected with the progress of science and technology. It is unfortunately true that one can find, in the course of history, many examples in which scientific achievements have been used for purposes of war. But the circumstances in which science was used for purposes of destruction seem to be, in my opinion, in spite of some catastrophic effects, isolated incidents in the general positive evolution of scientific research, an important component of the constructive activity of mankind. It is essential at the present level of knowledge to use scientific achievements only for peaceful purposes and for a lasting and general peace.

The actual dimensions of the world scientific phenomena permit science and technology to be transformed into a global component of the progress of welfare and independence of all nations. The domains of scientific research, as well as their use for peaceful purposes, have been considerably extended.

Research methods have become more and more precise and efficient, in spite of their complexity, which has concurrently grown. Scientific research results are applied at an ever more rapid pace. But the most important factor, probably, is the strong link between scientific investigations and man's needs, the increasing concern with solving the problems of mankind. Today, the aim of scientists is to find new energy and food resources, the causes of disease so that they might be avoided, the preservation of the environment, the fight against pollution in all its aspects, the discovery of scientific methods which will ensure a balanced and dynamic development of all countries. I would like to stress this idea. In its effort to give a very solid basis to the material and spiritual development of the collectivity, science has gradually passed from the intensive use of the mineral resources of the environment to the study of the ways for optimizing the use of these resources. Today, in the same context of mankind's intensive use of its entire resources, science elaborates the optimizing methods for the use of the human resources, not only through technical means, but also through the scientific organization and management of human activity, through the modern instruction and education of all the people of the community. It stands to reason that the present level of science and technology, and its practical force, are able to provide an affirmative answer to the hopes for progress and development of all nations. The extent to which all people can benefit from the achievements of science is questionable. This question is not new, and the answer has long been intensively sought by all people, irrespective of their level of development; the answer is sought by governments, international organizations and men of science.

Let us picture this distribution in the form of a very simple co-ordinate system whose spatial axis would cross all the areas of the earth, the intensity of the scientific investigation, the degree of the use of these results and, of course, the human efforts involved. We will discover that the spectrum of scientific phenomena is extremely discontinuous. Scientific investigations and the use of their results have gradually polarized, with important disproportions in the access to scientific achievement, in the contribution to its development. Of course, there are natural, social and historical causes which have produced this discontinuity.

A crucial problem before all nations, all governments, and of course all men of science throughout the world is to find the way to decrease and eliminate

this discontinuity. The problem is to make the spatial spectrum of science and the use of its results move from a polarized to a more continuous structure. Naturally, one can respond that a very long time will be necessary to discover these ways since, taking into account the limits of economic and technological development, the movement toward well-being for the whole world will conflict with available resources. Our aim is not to argue with the pessimistic theories of development. I think that the task of the men of science is to imagine, conceive and suggest methods for rational mobilization of human efforts toward balanced development under conditions in which all the nations could gain equally through the benefits of science. I am convinced that a high level of co-operation among nations on a technological and scientific basis is one of the most positive ways of solving this problem. The scientific and technological co-operation would represent, in my opinion, one of the superior forms of collaboration between nations, irrespective of their size and power. I say "superior" because the nation of science is at the pinnacle of human creation, and humanity in its essence is naturally inclined to understanding and collaboration. The history of recent centuries shows that this co-operation is possible and has increased. Co-operation among the large countries, as well as co-operation between large and small countries, demonstrate convincingly that it is possible to overcome the obstacles associated with the different types of the economic and social systems or the varying sizes of countries.

Although the aim of this co-operation is scientific and technological investigation, co-operation is to a large extent a political problem. That is why it seems natural that this co-operation should be based on healthy political systems, which should ensure both mutual respect for national dignity and the assurance of a high level of effective collaboration.

These political principles should promote the possibility of a high level of co-operation among all the nations, in various forms, multilateral, regional etc. They should assure the observance of mutual advantages and equality. This co-operation should stimulate the most efficient realization of all personal resources, material and human, within the same agreement of mutual benefits.

I think that the principles of international scientific co-operation should include as an important element the idea of mutual assistance, which can gradually decrease the differences between the developed countries and the less developed

ones. Without yielding to "scientific romanticism", I think that these principles should create a situation that, in the future, nations should have free access to scientific and technical achievements, similar to the present limited access to artistic creative achievements.

Without doubt, it is difficult, if not impossible, to give at present an answer to the question: how long will it take the technological gap between nations to disappear? It is almost certain that nations can only proceed rationally to diminish this gap. Both advanced and developing nations should assume great responsibilities in the long and difficult process toward the promotion of the co-operative spirit and the initiation of concrete steps toward co-operation. The vast experience of the advanced countries in the organization and revaluation of scientific and technological investigations could be a means for accelerating the progress of less developed countries. This experience could be of great help for solving the complex material problems of the world - for example, the future problems of energetics.

For their part, the developing nations should have a more positive attitude toward approaching technical and scientific investigations, since this co-operation can provide an important means for realizing their human and national resources. The future of a nation is guaranteed by the nation's own efforts, irrespective of the extent of international co-operation in which it takes part. Any developing nation should aim at directing the resources it possesses toward the continuous development of its own contribution to the progress of scientific knowledge, because only in this way will its future be in its own hands, and, therefore, will it be a future of dignity and independence.

I would like to stress the importance of highly trained scientific experts as one of the goals of large-scale international scientific co-operation. In the past, as well, an important number of experts from the developing countries had been trained in the more advanced countries. I am convinced that this is one of the most important forms of co-operation which should be emphasized in the future. Their knowledge and scientific and technological documentation are very important because they can accelerate the rhythm of progress at any given moment. The long range closing of the scientific and technological gap is equivalent to its closure by scientific and technical staff in the less advanced countries. Without its own strong scientific movement, without its own technology, without its own experts, a nation cannot dream of removing the economic and technical gap which separates it from the advanced nations and cannot contribute to the general progress

of humanity, even if it has the ambition to do so. In this context, I would like to stress once more that any action of scientific and technical co-operation which does not leave a deep impact on the education of experts will have no long range effects.

The access of the developing countries to modern science and technology, the acceleration of the process of alignment of these countries to the high technological level of the more developed countries, depends on the practical ways chosen for the achievement of many-sided scientific and technical co-operation on a world scale. In the last 10-15 years many means of co-operation have been practised, and they have often been successful, which has finally demonstrated the possibility and utility of scientific co-operation between the developed countries and the developing countries. Our main task today is to use with more courage those means of co-operation which have proved viable, and to extend them. Scientific countries all over the world, irrespective of their level of development, have an essential role to play in clarifying which one, among the various available forms of co-operation, should be used. It is the duty of the man of science to emphasize to his government the main fields towards which co-operation should be orientated, to formulate the concrete methods whereby this can take place, and to use his proficiency and prestige in order to increase the rhythm of co-operation and the exchange of scientific and technical values.

Co-operation based on bilateral relations between countries is an obvious form of co-operation. Experience has demonstrated that direct forms of co-operation between research institutes or universities in countries with different scientific or technological levels can be very effective. In this respect, I can quote the results obtained by the experts from the Polytechnical Institute of Bucharest, experts from Electricité France and from the University of Wisconsin (USA) who approached in common problems concerning the transport of electrical energy and of internal combustion engines.

The development programmes supported by the more advanced nations in the developing countries on problems of common interest have a deep effect. For example, a group of university and research people from Romania are carrying out an electronics project in Algeria and also the reorganization of some laboratories.

Programmes of fellowship study, Ph.D., and specialization should be firmly promoted in the future on the same bilateral basis by the developed countries. These should be directed toward young experts from the developing countries, from

universities, industry or scientific and technological research institutes. The advanced nations can facilitate the access of specialists from the less developed countries to up-to-date information by establishing scientific and technical libraries. There has been a promising beginning in this respect, but compared to the present level of scientific and technical information and the considerable practical importance of libraries as a documentary resource, it is still only a beginning. Of course, the promotion of such means of co-operation as were briefly mentioned here, is possible and potentially effective on a multilateral basis as well. I would like to stress that, irrespective of the bilateral or multilateral nature of the scientific and technical co-operation, such co-operation is effective only if it forms part of a plan of intense and mutually advantageous economic relationship, encouraging and stimulating the exchange of material or scientific-technological values in both directions, and aiming at the gradual development of the less advanced partners to the level of the advanced partners. In this respect, the advanced nations have a very important influence. The access of the developing countries to the best scientific and technological equipment is still a problem which has been insufficiently solved. Of course, the economic or political implications of this problem cannot be disputed. One can never speak of reducing the scientific and technical gap between nations without permitting thorough access of the developing nations to achievements in the field of equipment, technologies and materials.

International organizations play an important part in directing scientific and technical co-operation toward the realization of concrete programmes of development. I will not dwell on the meritorious efforts of such organizations as the UN, and its special agencies UNDP, UNESCO, FAO, ILO etc., in promoting a spirit of co-operation and in creating scientific and technical bases in fields of immediate interest to the developing countries. Amongst these well-known efforts I would like to mention the experience accumulated in my own country, which is a developing country. Romania has benefited, or is benefiting, through development programmes in fields of great importance, such as: management of the economy; agriculture; hydrology; atomic physics; computing technology; solid state physics; and precision mechanics. I am firmly convinced that these forms of co-operation which ensure collaboration with highly competent experts from the developed countries, as well as the easier access to certain equipment, has had

a great effect over the long run. By these means, in a short time, many experts can be trained and real research institutes can be created, the future impact of which on the technological development of a country is indisputable. However, the obligation of every nation which receives scientific and technical assistance to its own material and human effort must be emphasized. Without important personal investment efforts made by the Romanian government, the above-mentioned international development projects would have, without doubt, had a lesser impact.

I think that, in the future, it is necessary that men of science all over the world collaborate more actively within international organizations, and through their governments, for the better direction of international development programmes towards the vital fields of science and technology - energetics; the science of materials; management; environmental protection; automatics; electronics; and cybernetics - some examples on which the rapid and balanced progress of our nation depends. I would like to suggest that access of the developing countries to science and technological achievements would reduce the scientific and technological gap between nations; it should become a more consistent preoccupation of international organizations, which should organize more frequent exchanges of opinions and meeting on this theme.

SCHLESINGER'S NEW STRATEGY AND EUROPE

At the beginning of this year the US Secretary of Defence James R. Schlesinger announced a significant shift in the official US strategic posture. He justified his new policy on the basis of the advancing technology and, particularly, the vigorous ICBM and MIRV programs of the USSR observed in summer 1973. The new policy was based on assured deterrence like the earlier one, but with more emphasis on counterforce targeting, "increased selective targeting options". The purpose of this article is to summarize Schlesinger's new strategy and his development programs, to review a few articles evaluating it which already have appeared, and to present my personal opinion.

1. The preemptive debate

It might have been possible to predict from President Nixon's foreign policy reports since 1970 (1-4), that some changes in the American strategic weapons policy were pending. Secretary of Defence Melvin Laird's "strategy of realistic deterrence" or "doctrine of sufficiency" (5) already reflected a shift by stressing some new features to the strategy of Mutual Assured Deterrence ("MAD"): requests of "comparable mutual damage" and "defence against small scale or accidental attack".

Some articles demanding a change to the MAD policy appeared already in 1973. Fred Iklé, a former colleague of Schlesinger at the RAND Corporation, now Director of the US Arms Control and Disarmament Agency, prepared the way to a doctrinal change (6). Iklé wrote that the difficulty with the MAD doctrine is that the US strategic forces must be structured for a retaliation, which must be prompt, massive and targeted against value objects (cities and industry). Furthermore, the MAD doctrine presupposes that the opponent must be thinking according to the same theory in order for the deterrent to be effective. This requirement disregards the possibility of a nuclear war breaking out by accident. In fact, the constant need of alertness required by the promptness of the retaliation might even increase the risk of accident. Even well-known US strategists have recommended a launch-on-warning policy. Iklé recommends a policy of counterforce and defence using modern weapons of high accuracy and relatively small yield. Colin S. Gray (7, 8) criticized the MAD policy mainly on moral bases. He, too, maintained that the new technological developments offer the promise of a more sensible war-waging strategy than the MAD doctrine. The claims of counter-force policy were rebutted by Wolfgang Panofsky (9) and Herbert York (10). Panofsky wrote that although the MAD doctrine rests primarily on the threats of retaliation, it does not necessarily require prompt and massive strikes. He points out, that even though the nuclear strike were confined to the opponents military facilities only, civilian



casualties would be high with the present and foreseeable weapons. Furthermore, whatever technological preparations for a "surgical" counterforce US would make, there exists no way to protect its own population. York (10) stressed that a counterforce strategy is likely to require many more and generally larger weapons than a deterrence strategy. A failure might result in many more deaths, especially in third countries, than the failure if the force were designed for deterrence only. He concludes that the current nuclear doctrine provides the best crisis stability and arms race stability presently available and recommends maintaining the "assured deterrence" stable by reducing the forces by mutual agreement rather than going to a counterforce strategy, which is "among the most dangerous proposals" he knows.

## 2. Secretary Schlesinger's new policy

Although the above debate predicted some change in the US strategic posture, the change of the official policy, as announced by Secretary Schlesinger on December 15, 1973 (11) and January 10, 1974 (12), was much more dramatic than could be expected in a period of detente.

In his January 10 interview (12) Schlesinger presented the justification and broad outlines of his new policy. He said, that during last fall, it became evident that the USSR was developing "4 new ICBM's; three of them have now been tested by MIRV's". One of these new ICBM's, numbered SS-18 by NATO, is reported to be larger than the up-to-now heaviest Soviet ICBM, and appears to be particularly worrying the USA. According to Schlesinger the USSR also has "three fleet ballistic missile submarine programs in operation". Due to its lead in MIRV technology, USA could afford to consent, in SALT I (see Table 1) to an approximately 50 % higher number of launchers and an about twice higher payload to the USSR. Schlesinger now remarks (12): "Our concern is that, if they (USSR) marry the technologies that are now emerging in their R&D program to the throw-weight and numbers that they have been allowed under the interim agreement (of SALT I), they would develop a capability that was preponderant relative to that of the United States, and this is impermissible from the standpoint of the American government so long as we bear the obligation to carry the nuclear shield not only for ourselves but our allies.

If the Soviets were able to develop these improved technologies presently available to the United States in the form of guidance, MIRV, warhead technology, at some point around 1980 or beyond, they would be in a position in which they had a major counterforce option against the United States, and we would lack a similar option. Consequently, in the pursuit of symmetry, meaningful symmetry, for the two forces -- and by meaningful symmetry, I do not mean symmetry in every respect -- we cannot allow the Soviets unilaterally to obtain a counterforce option which we ourselves lack. We must have a symmetrical balancing of the strategic forces on both sides".

In his Annual Defense Department Report FY 1975 (13) Schlesinger then presents in great detail his policy: a) a doctrinal change - a need for more options, especially counterforce options, for selective targeting - and b) demands for a great number of improvements to the present weapons, and procurement and development options for new strategic weapons systems as "prudent hedges" for the Soviet programs.

a) Selective targeting

To forestall direct nuclear attacks on the USA is not the only objective of its strategic nuclear forces; they also exist to "inhibit the coercion of US by nuclear powers" ... and "coercion of its allies by such powers". - It seems that because of the strategic nuclear parity the selective targeting has become a precondition for American nuclear guarantee to NATO. Flexibility of response is also essential in cases of accidents and unauthorized acts, conventional conflicts, and, "if ill-informed or cornered and desperate leaders might challenge us to a nuclear test of will" (13). This flexibility of response may demand also "a more efficient hard-target-kill capability than we now possess", but how much such capability is needed depends on the progress of the current phase of the SALT talks. The hard-target-kill capability can be achieved by the combined effect of accuracy, nuclear yield and the number of warheads applied to the target. The selective targeting thus also may demand qualitative improvements and quantitative increases.

- Capability to select flexibly targeting options will again make nuclear weapons useable as political instruments.

b) The "sizing" of forces

The sizing of the nuclear forces is partly separable from the doctrinal issue. It is labelled as precaution against the Soviet strategic programs. Schlesinger is afraid that if the Soviet programs, especially the MIRV'ing of the heavy SS-18, are fully deployed, the US ICBM fleet may become obsolete at the beginning of the 1980s (see below). US did not expect deployment of MIRVs in such a large scale by the USSR, when it approved SALT I: "The scope of the Soviet program as it now has emerged is far more comprehensive than estimated even a year ago" (13). Schlesinger then lists a number of Soviet ICBM programs, among them a land-mobile version of SS-16 which "may be under development". He says: "If all three of the new and heavier missiles are deployed, throw weight in the Soviet ICBM force will increase from the current 6-7 million pounds to an impressive 10-12 million pounds. This throw weight, combined with increased accuracy and MIRV's, could give the Soviets on the order of 7000 one-to-two megaton warheads in their ICBM force alone. ... a force of about 300 of these missiles (permitted under the Interim Agreement) could pose a serious threat to our ICBM's in their silos, even after those silos are upgraded".

### 3. Comparison of the US and USSR strategic force levels

Before reviewing the strategic programs proposed in this year's US defence budget, it is useful to briefly review the strategic force levels. The actual levels, as presented by Schlesinger (13), are shown in Table 2. It can be seen that USA has about three times more warheads than USSR, which again has about 50 % more ICBM launchers than USA. The USA warhead number will grow to about 10000 in 1977. If Soviet Union fully deploys its MIRV'ing possibilities, it may have an about equal number in 1980. USSR has 25 large empty silos, evidently intended for SS-18; furthermore, it probably can (according to Schlesinger) replace its SS-9 missiles by the heavier SS-18 by enlarging the silo.

The effectiveness of the missiles depends on the accuracy and yield and is illustrated in Table 3 (14). As can be seen, the relatively good accuracy and tremendous yield of SS-9 provides it with a very high hard-target-kill capability, 96-97 %. The major offensive US systems/~~are mentioned~~ <sup>developments</sup> in Table 4 (according to 13). In addition to these major developments, a large number of other programs like initial strategic development programs, strategic defence, command and control, and civil defence programs, are included. Defence Monitor (14) lists altogether 28 strategic programs for the FY 1975. The programs listed in Table 4 only cover \$ 3.8 billion of Schlesinger's \$ 23.1 billion weapons program (see p. 10).

### 4. Initial critics of Schlesinger's policy and program

Some initial debate on the Schlesinger policy has already caught my attention. First two articles reviewed below, however, are on SALT. They are not directly dealing with Mr. Schlesinger's announcements but are highly relevant in this connection. Herbert Scoville (15) emphasizes that the MIRV control is still possible and meaningful and should deserve the highest priority in SALT II, because full deployment of MIRVs and improvement of their effectiveness could make the fixed land-based ICBMs obsolete in a few years and their replacement by, eg., mobile ICBMs would be extremely expensive and perhaps destabilizing. MIRV-testing is observable by radars. US MIRVs do not yet have a first strike capability (without terminal guidance). Of the Soviet missiles only SS-9 has a high hard-target-kill capability, but the emerging SS-18 MIRVs could also have the same. They might have an accuracy of about 400 m CEP<sup>\*</sup>, which means that by a 1 MT warhead a 90 % probability for destroyance of a 300 psi silo would be reachable. If the US silos are hardened to 900 psi, 230 m CEP would be needed with this yield. But USSR has only 25 large silos now ready for SS-18, which would correspond to  $25 \times 6 = 150$  warheads.

One can, indeed, easily see that by replacing about 150 SS-9 by MIRV'ed SS-18 (900 warheads), Soviet Union would get a force capable of complete destroyance of the US Minuteman force (150+900 MIRVs+138 SS-9= 1288 warheads having better than 90 % hard-target-kill probability).

\* CEP = Circular Error Probable, radius of the circle around the target wherein 50 % of the warheads fall.

USA will have mid-1976 550 Minuteman III = 1650 warheads, CEP ca. 400 m; yield ca. 200 kt (cf. in Table 3: 320 m, 160 kt). The hard-target-kill probability remains low, around 50 % for a single warhead. This force, then, could not threaten the total Soviet land-based missile force, 1618 launchers. However, if the CEP could be reduced to about 230 m and all the 1000 Minuteman would be MIRVed, it could. US also has a large number of Poseidon MIRVs, but they have a small yield (40-50 kt) and low accuracy (CEP 500 m) and cannot seriously threaten hard targets (see Table 3). Scoville proposes that the two worst possibilities, MIRV'ing of all the 1000 Minutemen by the US, and replacement of all the 288 SS-9 by MIRVed SS-18 by the Soviet Union, should be barred by SALT II. USA could stop at 550 Minuteman III, and USSR at 25 SS-18, which would mean rough comparability. Testing of new terminal guidance systems should be prohibited. US has a tremendous lead in SLBM MIRVs, but their hard-target capability is not high, as we have seen. Soviet Union has a large enough missile (to be usefully MIRV'able) only in its new D-class submarines, but it is probably not interested in MIRV'ing them, because this would greatly reduce their range (4000 mi), which is more important. It could propose to refrain from MIRVing them, if US would stop its useless Trident program. Thus, it would still be possible to stop the MIRV race at the last moment.

Lawrence L. Whetten (16) writes that Soviet Union was not interested to have restrictions for MIRVs in SALT I (probably because USA was too far in its MIRV program, already). Its interest for MIRV-limits may now be greater, when it has tested its own MIRVs. The 23.1 million dollars, which the US Air Force got just before Brezhnev's visit (June 1973) into the FY 1974 budget for keeping the MIRV option open for the remaining 450 Minutemen, may have been a "bargaining chip". The Soviet non-interest for MIRV'ing was perhaps due to the fact that it counts its need of launchers on the basis of targets, ie. the US ICBMs. MIRV'ing has not changed their number, nor has it changed the counterforce effectiveness of the US ICBM force. Whetten, too, considers an agreement limiting the warhead numbers of land-based forces still verifiable and feasible.

Lawrence Martin (17), in an excellent review of Schlesinger's policy, has also reviewed its implications to Europe. He writes that "there are one or two special implications of Mr. Schlesinger's strategy for Europe": "It can be argued, for instance, that accurate strategic systems could replace the Forward Based Systems", and "Mr. Schlesinger's assistant Mr. William Beecher has suggested (Time, 1 March 1974) that a selective hard-target capability could deal with the Russian medium-ranged ballistic missiles (MRBM)" ... "But the essence of Mr. Schlesinger's strategy for Europe remains the idea that in selective targeting the United States may discover some form of deterrence she could credibly wield against the Soviet Union when acting on Europe's behalf". Martin's final comments are: "In general conclusion it must be said that the initial alarmed European

reactions to Mr. Schlesinger's utterances seem to have been excessive". He also says: "A third, and sobering, thought for Europeans is that a considerable part of the difficulty Mr. Schlesinger's strategy attempts to deal with, arises from their inability or unwillingness to provide for their own defence".

Frank Barnaby (18) in SIPRI yearbook 1974 (chapter 5) reviews the nuclear deterrence debate. After reviewing Iklé's (6), Panofsky's (9) and York's (10) articles Barnaby reviews in some detail Schlesinger's policy as announced in the January 10 interview (12). He points out that USA has had for several years already a considerable counterforce capability and corresponding targeting policy; "over 4000 of its nuclear warheads must have been targeted on military targets for the past few years... Therefore, Schlesinger's announcement is not a change in the US nuclear strategy but just a decision to announce it". It "signals the desire of the current administration in the USA to produce and deploy weapon systems that could not be justified ... in the context of the strategy of assured destruction ...". Barnaby lists three probable main reasons for Schlesinger's announcement:

- 1) to influence allies by reinforcing the credibility on nuclear guarantees,
- 2) to influence the Senate to give more funds for strategic weaponry,
- 3) to influence the Soviet Union in the SALT negotiations.

Barnaby writes: "The counterforce strategy, as enunciated by Schlesinger, includes the humanitarian implication that the USA should acquire a "surgical strike" capability ... This posture ... requires warheads with very high accuracy and very small nuclear charge; such weapons are not currently deployed in the USA arsenal. But mini-nuclear warheads and terminal guidance that endows warheads with pinpoint accuracy are ready for procurement and deployment". "Project ABRES (see Table 4) has succeeded in perfecting a terminal guidance system that, when incorporated in a maneuverable re-entry vehicle (MARV) can guide it onto a prescribed target". Barnaby concludes pessimistically, that "once again the synergy of political utility and strong organisational and bureaucratic pressures in the United States will most probably induce a new cycle of strategic weapon procurement and deployment". He sees the counterforce posture to have four serious ramifications:

- 1) Insistence on the capability of "surgical strikes" tends to move strategic nuclear weapons closer to the tactical arena.
- 2) MARV would provide the USA with undeniable first-strike capability against land-based missiles.
- 3) MARV would justify installation of mobile platforms, and
- 4) Perhaps the greatest danger: the effort of counterforce policy "to make the surgical strike credible and acceptable".

Referring to York (10) Barnaby recommends that instead the "new policy", the US should, in SALT II, to seek an end to the qualitative improvements and a reduction of the number of nuclear arms.

On the tactical nuclear level he refers to the article of the Los Alamos workers Bennett, Sandoval and Schreffler (18), who recommend, that NATO should replace the uncertainty of an irrational nuclear response (the flexible response) with a certainty of an immediate, effective nuclear response. They recommend a vigorous modernisation and miniaturisation of the tactical nuclear weapons; they believe that such weapons, together with the limitation of the goal to the preconflict borders and advertizing certain ground rules (including maximum yield) would keep the war limited.

Barnaby stresses, that though such a policy might seem tactically attractive, it has fundamental weaknesses like the risk of escalation - blurring of the distinction between conventional and nuclear war. "But perhaps the most immediate requirement is for the political decision makers to understand and recognize the urgent need for nuclear disarmament ...".

The latest contribution in this debate is the article of Greenwood and Nacht (19). After listing the pros and cons of the counterforce - policies they describe their own variety, "the strategy of restrained options". It emphasizes

- 1) the contingency planning, studies of deterring the low-level attack and preventing escalation;
- 2) the flexibility of targeting - providing oneself a broad but restrained set of nuclear options, and
- 3) more effective command and control systems.

They see "the need to gain leverage for the use at SALT" as an underlying promise of the new policy" and are skeptical about the Administrations's reliance on bargaining chips. The new strategic programs may be difficult to control - they may get "their own momentum". They think that "one could size and structure the American strategic forces almost independently of the Soviet force structure" and recommend unilateral act of restrain to curb the arms race.

G. A. Arbatov, Director of the USA Institute of the Soviet Academy of Sciences, is most critical of the American strategic debate (20). He sees the debate to be an attempt of some military circles in the USA to find ways of waging a war safely. These circles propose waging a local war by proxy using "allied" manpower and providing it with US technology. He writes that some recent American critics of the traditional "restraint by deterrence", "although perfectly ready to speak in humane terms about the inhumanity of a concept of a peace maintained by the threat of the destruction of tens and hundreds of millions of people, in fact have in mind something which is far from peace and disarmament". Instead, they try to restore the nuclear military power its full usability by making the prospect of nuclear war more acceptable. Also the tendency to "miniaturization" of nuclear weapons is thus justified. He considers the idea of introducing "rules of the game" and of artificial limitations "by agreement" to a limited nuclear war to be based on an illusion and to be without justification.

### 5. Schlesinger on NATO strategy

In a statement before the US Senate Foreign Relations Subcommittees (21), Secretary Schlesinger discussed in general terms the deployment of US nuclear weapons in Europe. He said that NATO defence is based on "NATO Triad":

- 1) strategic forces, primarily provided by the USA,
- 2) tactical nuclear forces, and
- 3) a "stalwart conventional capability".

"How much of that burden can be assumed by tactical nuclear capabilities, continues to be a matter of continuous discussion ... NATO still needs improved doctrines for the tactical use of nuclear weapons. This includes the ability to control escalation ...". Schlesinger recommends particularly reduction of the vulnerability of the nuclear systems and underlines that "the Alliance should consider whether, in the future, there are serious possibilities of replacing the existing stockpile with nuclear weapons and systems more appropriate to the environment of Eastern and Western Europe". "Basically, these forces should have the capability of the following:

- quick dispersal to match a Warsaw Pact surprise dispersal;
- survivability and controlability while dispersed;
- denying the enemy his military objectives without excessive collateral damage;
- providing for selective, carefully-controlled employment options; and
- penetrating enemy defences".

He then describes the consultation and authorisation system within NATO and US administration and emphasizes the recent measures to safeguarding the US nuclear weapons and their storage environment.

It seems that Schlesinger proposes no major change to the NATO strategy. He, too, recommends it to be based on deterrence by flexible response. There is an emphasis on improvement of conventional defence and command and control but there is also emphasis on modernisation and miniaturisation of tactical nuclear weapons, eg., by providing the howitzer shells by Precision Guidance Systems (12) and by improving the survivability and safeguards of the systems. On the whole, Schlesinger is rather cautious regarding the role of the tactical nuclear weapons. In his defence budget (13) he writes: "While it is essential to theorize about the nature of tactical nuclear warfare, we must acknowledge that as a practical matter, the initiation of a nuclear engagement would involve many uncertainties. Acceptable boundaries on such a conflict would be extremely difficult to establish. A nuclear engagement in the theater could well produce much higher military and civilian casualties and more widespread collateral damage than its non-nuclear counterpart, depending, of course, on the character and length of the engagement. What is more, it is not clear under what conditions the United States and its allies would possess a comparative military advantage in a tactical nuclear exchange".

## 6. Conclusions

As for the counterforce policy and increased need of nuclear options, there is no doubt that a change has been pending quite a few years, due to the advancing technology and particularly, the increasing Soviet capability. As Barnaby points out, USA has had a mixed targeting policy for many years already. It is evident, too, that among the reasons for the great publicity that Schlesinger is now giving to his "new policy" are, eg., need to influence

- 1) allies (to improve the credibility of the US nuclear guarantees),
- 2) the US Senate (to approve more funds for strategic programs) and
- 3) the Soviet Union (to get concessions in SALT negotiations).

Schlesinger wants to channel the savings from the reduced Vietnam engagement into strategic weapons development programs. On the other hand, Schlesinger has some justification in his worries about the fate of the US ICBM fleet. One astonishes the massiveness of the Soviet missile and MIRVing programs in a period of detente. Yet, one gets the impression that Schlesinger's reaction is unreasonably vigorous, an overreaction. The Soviet programs may represent bureaucratic decisions made many years ago. USSR is five years behind the USA in its MIRV tests and it is extremely unlikely that it would intend to reach a warhead number anywhere near 7000 during the 1970s, as feared by Schlesinger. This would require the very expensive early replacement of its still quite capable SS-9s.

In the name of "efficient equivalence" Schlesinger demands in reality strategic superiority even for the land-based ICBMs: his "selective targeting" means hard-target-kill capability with minimal collateral damage, something that the Soviet Union does not have and will not have during the 1970s, because its limited silo-killing capability (based on the 20-25 Mt SS-9s and the 1-2 Mt SS-18 MIRVs) will be based on high yields rather than pinpoint-accuracy and certainly will not be devoid of collateral damage. The US collateral-damage-avoiding capability will be futile, however, because the US population, unlike the Soviet one, would suffer immeasurable losses even from a 100 % counterforce exchange. Self-deterrence will therefore certainly prevent the US from "surgical strikes" unless it turns to the immensely expensive Damage Limitation strategy, which would be more difficult to realize in the US society than in the well-disciplined Soviet society, which has better civil defence, public transportation and experience in city-evacuation. Therefore, it is not prudent to the USA to seek a more war waging policy than the USSR. It should rather attempt to contribute in stabilizing the relatively safe balance of assured destruction until a better situation can be reached by nuclear disarmament. Secretary Schlesinger's strategy for NATO also follows the old lines. He attempts to reinforce the credibility of the strategic guarantees, which were given in an other era and which the US no longer can fulfil. He also continues to improve the contradictory flexible response by asking for a better conventional defence (which is correct) but also for modernisation of the tactical nuclear arsenal



(which is the wrong thing to do), although he seems to be rather uncertain regarding this factor, since he warns of placing too much emphasis on it. He could go one step further and recommend that both sides withdraw their theatre nuclear weapons and agree about non-first use of nuclear weapons in Europe. The theatre weapons do not have any deterrence value of their own (except perhaps against the first use of the other side) but they increase the risks by ambiguity and their existence leaves too much of the defence into the hands of the superpowers which, in Central Europe, would be fighting on a foreign territory. In the last moment of truth none of the European countries would allow use of theatre weapons in their territory. Self-deterrence would be more effective. Any defence which is based on "possible first-use" of theatre nuclear weapons, rests on a foundation of mud. Any deterrence that would be needed on the theatre level could be taken care of, eg., by earmarking a couple of Poseidon submarines for interdiction role in Europe. They would be much less vulnerable than the present arsenal of almost 10000 American and almost 5000 Soviet tactical nuclear weapons in Central Europe.

USA has a clear-cut superiority regarding Soviet Union in all the other fields of strategic forces than the ICBMs: the SLBMs, bombers, FBS:s and the geography (it has foreign military bases all around the USSR), which Schlesinger hardly mentions. Insistence on extremely expensive and excessively heavy "hedges" against a rather unlikely Soviet hard-target-hit superiority in the single field of land-based missiles at the end of the 1970s simply is not convincing. Schlesinger's demands are probably in the first place "bargaining chips" for SALT, in the second place intended to keep the military-industrial complex functioning smoothly by channelling the Vietnam savings (and much more) to the industry. Schlesinger's military budget for the FY 1975 is an all-times record. As explained by Senator John C. Stennis, Chairman of the Senate Armed Services Committee, "the sum of these two requests (obligational authority for FY 1975, 92.2 billion and \$ 6.2 billion supplemental funds for 1964) is \$ 99.1 billion" and "this sum compares to \$ 80.2 billion" which was appropriated for FY 1974 (22). That means a 25 % increase in a single year! Yet, Schlesinger got essentially all he demanded: he asked for \$ 23.1 billion, obtained \$ 21.8 billion for weapons purposes.

US Atomic Energy Commission develops and procures the nuclear warheads on a separate budget. When its weapon program is added to the above \$ 99.1 billion, it breaks the \$ 100 billion barrier. This budget is unique in war or peace time. It is hard to estimate how much of Schlesinger's demands were "bargaining chips", Unfortunately, even those perhaps primarily aimed as bargaining chips, take up momentum, and soon start living their own life, as has been seen regarding so many previous system, MIRVs and ABMs included. Unfortunately, the Soviet Union has not published any justification for its new, vigorous missile program. The Soviet critics who have written about the US strategic debate see as its only reason "that

some US military circles thus seek means and ways of waging nuclear war". Such analysis can hardly be considered to be objective, either. It is evident that most of the present acceleration of the strategic arms race is due to the stalemate in SALT negotiations. Perhaps the SALT has not been negotiated very skilfully. Paul Nitze, the former head of the US SALT delegation in Geneva, was recently rather critical about the way how President Nixon and Secretary Kissinger have carried out the negotiations (23). Actually, he resigned as a protest. This seems to be yet another case when the bargaining chip policy has not been fruitful. It seems that the leadership, probably in both countries, should have a different attitude to the SALT talks. As Barnaby says: "Perhaps the most immediate requirement is for the political decision-makers to understand and to recognize the urgent need for nuclear disarmament so that they will resist those vested interests within their societies which press for the application of all possible technological advances to weapon system development, for the deployment of all new weapons that are developed and for the maintenance and improvement of all existing weapon systems".

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Table 1. Maximum numbers of strategic weapon systems allowed by SALT I for 1972-1977.

Weapon system	USA	USSR
ICBM launchers	1000-1054	1408-1618
SLBM launchers	710	950
Ballistic missile submarines	44	62
ABMs	2 sites, 100 <sup>1/</sup> missiles each	2 sites, 100 <sup>1/</sup> missiles each

<sup>1/</sup> 3 July 1974 reduced to one site, 100 each.

Table 2. US and USSR Strategic force levels (J. R. Schlesinger (13)).

Offensive	Mid-1973		Mid-1974	
	USA	USSR	USA	USSR
ICBM launchers <sup>1/</sup>	1054	1550	1054	1575
SLBM launchers <sup>2/</sup>	656	550	656	660
Intercontinental bombers <sup>3/</sup>	496	140	496	140
Force loadings weapons	6784	2200	7940	2600

<sup>1/</sup> Excludes launchers at test sites

<sup>2/</sup> Excludes launchers on diesel-powered submarines

<sup>3/</sup> Excludes bombers configured as tankers and reconnaissance aircraft

Table 3. Numbers, accuracies, yields and effectiveness of the strategic missiles of US and USSR - 1974.(according to Defence Monitor (Vol. 3, No 4, May 1974)).

## U.S. Strategic Missiles - 1974

Name	Number	Accuracy*	Yield	Hard Target+ Kill Capability
<b>ICBMs</b>				
Minuteman I	100 (will be none by mid-1975)	.75 miles	1.0 megatons	PK = 18%
Minuteman II	500 (will be 450 by mid-1975)	.35 miles	1.5 megatons	PK = 60%
Minuteman III (3 MIRVs)	400 (will be 550 by mid-1975)	.20 miles	160 kilotons per RV (reentry vehicle)	SSKP = 56% PK = 92%
Titan II	54	.75 miles	10 megatons	PK = 58%
<b>SLBMs</b>				
Polaris A-2	272 (will be 160A3s by 1977)	1.0 miles	800 kilotons	PK = 9%
Polaris A-3 (3 MRVs)		.70 miles	200 kilotons per RV	SSKP = 7% PK = 20%
Poseidon C-3 (10 MIRVs)	384 (will be 496 by 1977)	.30 miles	40 kilotons per RV	SSKP = 13% PK = 76%

\*Accuracy is measured according to Circular Error Probable (CEP) in nautical miles. CEP is a statistical estimate that on the average 50% of the missiles will land within a circle with a radius from the target of the CEP value.

+Hard target kill capability is measured in terms of the probability of kill (PK) or single shot kill probability (SSKP) in the case of MIRVs of a missile against a 300 PSI target (the approximate hardness of most U.S. ICBM silos). The General Electric Missile Effectiveness Calculator was used to make these estimates. The values are very approximate and the relative capabilities between various missiles are probably more accurate than the absolute values. Reliability factors make such estimates even more complicated. A PK or SSKP of above 90% is considered a good hard target kill capability.

## U.S.S.R. Strategic Missiles - 1974

Name	Number	Accuracy*	Yield	Hard Target+ Kill Capability
<b>ICBMs</b>				
SS-7	100	2.0 miles	5 megatons	PK = 8%
SS-8	109	1.5 miles	5 megatons	PK = 13%
SS-9	288	.5 miles	20-25 megatons	PK = 96-97%
SS-11 Mod 1	970	1.0 miles	1 megaton	PK = 10%
SS-11 Mod 3 (3 MRVs)	40	1.0 miles	500 kilotons per RV (reentry vehicle)	SSKP = 7% PK = 20%
SS-13	60	.75 miles	1 megaton	PK = 18%
<b>SLBMs</b>				
SS-N-6	528	1.0 miles	1 megaton	PK = 10%
SS-N-8	108	.75 miles	1 megaton	PK = 18%

\* and +: see footnotes to table "U.S. Strategic Missiles-1974".

Table 4. Major US offensive strategic forces modernization and improvement programs (according to 13).

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	Fy 1975 dollars in millions
1. Continued installation of Minuteman III	758
2. Continued deployment of Poseidon	192
3. Continued development of the new Trident submarine	2043
4. Development of Advanced Ballistic Reentry Systems (ABRES)	120
5. Modifications to the strategic bombers B-52D	73
6. Continued development of a new strategic bomber B-1	499
7. Development of bomber launched and submarine launched versions of a new strategic cruise missile	125
8. Development of an advanced tanker/cargo aircraft	20

TIME TO CUT MILITARY EXPENDITURES

It is almost incredible that no way has yet been found to cut military expenditures. No matter what the international climate -- whether hot war, cold war or détente -- national and global military budgets keep right on escalating.

Since 1959 more than a dozen multilateral and bilateral (US and USSR) arms control agreements have been concluded, including such important ones as the Partial Test Ban Treaty in 1963, the Nuclear Non-Proliferation Treaty in 1967, the Strategic Arms Limitation Agreements at the Moscow Summit in 1972, and the Agreement on Prevention of Nuclear War at the Washington Summit in 1973. In the same period of time world military expenditures have more than doubled -- from \$97 billion in 1959 to more than \$220 billion in 1972, representing an increase in constant prices of more than 50 per cent. In fact, with the devaluation of the dollar, the current figures are much higher -- in the neighbourhood of \$250 billion. This sum is about twice the amount spent by all governments on education, about 3 times what they spend on health and about 30 times what they spend on aid to developing countries.

In the United States alone, the Administration in January 1973 proposed an increase in the military budget from \$76 billion to \$81 billion. The actual amount approved in 1973 was \$84.2 billion. In January 1974, the President proposed a further increase to \$99 billion. The amount asked for the Defense Department was \$85.9, but additional military outlays included for the Atomic Energy Commission, for science and technology, and for supplementals brought the total to about \$100 billion.

The United States' budget is the easiest to use as an example but the story is similar all over the world. Civilian programs are being starved while the military ones proliferate and sophisticate like and uncontrollable cancer.

In addition to posing the fearful threat of ultimate disaster, the continuing arms race exacts an appalling toll in terms of human welfare in the rich as well as the poor countries. On both the national and the international level the world is afflicted by the threat of the three p's -- poverty, population and pollution. To grapple with them with any real chance of success, the enormous sums now wasted on the arms race must be rechanneled to productive economic and social goals.

The paradox is all the more puzzling because of the end of the cold war and the recent improvement in the international climate. China and the two Germanys are now Members of the United Nations. American troops have been withdrawn from Viet-Nam, the United States and the USSR in their SALT agreements have agreed to stabilize the deterrent, to give up the race for nuclear superiority and to take action to prevent the outbreak of nuclear war between themselves or others. There is a conference on security and co-operation in Europe and another conference on mutual force reductions in Europe. And still the military budgets spiral upwards.

As indicated in the paper "A New Approach to Comprehensive Disarmament" (XXIV - 7), even if the negotiations in all of the above conferences are successful, the technological and qualitative arms race and the massive military expenditures will probably continue to escalate, unless action is taken to prevent this happening. All the present negotiations seem to be designed to institutionalize and regulate the arms race so that it can continue in relative security.

Reasons, old or new, for continuing the arms race and crushing military expenses are easily invented, discovered and periodically rediscovered.

Somehow military establishments all over the world find persuasive pretexts for upping their budgets. To take the U.S. : in the 1950's there was the evanescent bomber gap; when the Soviet Union launched the first sputnik in October 1957, the Pentagon promptly discovered the missile gap. Early in the Sixties the cry went up for underground shelters and by the end of that decade a "thin" defence, and then a "thick" defence, of anti-ballistic missiles were being hailed as the way to survive a nuclear attack.

There never was a bomber gap or a missile gap. Underground shelters and anti-ballistic missile defences are useless or worse.

\* \* \* \* \*

The short-term problem should be met head on, not by interminable debate about limiting or reducing specific weapons or the number of troops, but by cutting military budgets. The big two -- the US and the USSR -- should take the lead. Next should come the three other nuclear powers, followed by all the NATO and Warsaw Pact countries, and eventually by all countries. It would not even be necessary to specify how and where military budgets should be cut; it would be better to leave it to the individual countries to decide in what sectors they



would carry out the agreed reductions. Each country would no doubt regard itself as the best judge of where and how to apply or cut its funds; it will be difficult enough to get them to agree on whether and by how much.

Proposals for reduction of military expenditures have been made in different forms at different times over the post-war years by the Soviet Union, the United States, France and Great Britain. The Western powers were always concerned about how to ascertain the contents of the Soviet military budget and how to verify any Soviet budget cuts. In the early 1960's, when the cold war was still quite cold, one American disarmament negotiator pointed out that the entire published Soviet military budget consisted of 16 words and one sum. That remark ended any further discussion at that time of a Soviet proposal for a 15 per cent budget cut. Nevertheless, in 1964-64 the United States and the USSR each carried out budget reductions, not by agreement but unilaterally, by what the Soviet Union called "the policy of mutual example" and the Americans called "reciprocated unilateral acts". And there were no charges of bad faith by either side.

Moreover, times have changed, not only with respect to the international climate but also as regards the possibilities of verification of any agreement for mutual reductions. The great powers now have a much better knowledge of each others economic systems and technologies and have developed new techniques of economic monitoring; the remarkable recent advances in satellite, electronic and telecommunications surveillance may not be able to identify budgetary appropriations, but they can alert each side to any significant changes in the other side's activities; and intelligence information provides an additional deterrent or alert to any contemplated evasions. United States intelligence sources confidently reported last year that the Soviet Union had spent the equivalent of \$45 billion on manned space flight since the programme started 15 years ago, as compared with \$25 billion spent by the United States. The Soviet space programme and budget are no less secret than its military budget.

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The Soviet Union proposed in the General Assembly last September that the five Permanent Members of the Security Council (the five nuclear powers) reduce their military budgets next year by 10 percent and that a portion (10 per cent) of the savings be used to help the developing countries. This would leave 90 per cent of the savings for domestic purposes. Since these five countries are responsible for about three-quarters of the total of world military expenditures, the reduction, although a modest 10 per cent to begin with, would amount to more than \$15 billion.

The developing and third world countries of course supported the idea and it was approved by the General Assembly by an overwhelming vote of 83 in favour, 2 against and 38 abstentions. China was hostile to the proposal, calling it a fraud and hypocritical, and voted against it. The United States together with Britain and France and their NATO allies abstained; they regarded the proposal as a Soviet propaganda move and as an attempt to isolate China.

Mexican Ambassador, Alfonso Garcia Robles, recognizing that the Soviet proposal would remain a dead letter, proposed that Secretary-General Waldheim set up an international group of experts to carry out a study on the reduction of the military budgets of the five nuclear powers and of other states "with a major economic and military potential", and on using part of the funds saved to aid the developing countries. One would have thought that a proposal for an impartial study of these questions would have been able to rally unanimous approval. The Mexican resolution did in fact get more support than the Soviet one - 93 votes in favour, 2 against and 26 abstentions. China again was negative. The United States and its allies abstained, though in the past they had always supported the idea of impartial studies.

Ambassador William Schaufele, speaking for the United States, explained that he could not support the Soviet proposal. He said, there was, first, no common standard for comparing the military budgets of different states. Second, there was no system for verification of the budget cuts. And third, the United States opposed linking additional development aid to reduction in defence budgets. Schaufele agreed that the Mexican proposal was otherwise a non-controversial procedural resolution. But he thought the resolution contained an element of contention and an exaggerated sense of urgency, and that it implied a linkage between development aid and budget cuts.

Nonetheless, the United States has nominated an expert to participate in the study -- on the assumption that the group of experts would "examine carefully the various issues involved ... and that the Secretary-General would request Member States to provide data necessary to make that examination meaningful".

The group of experts is now meeting and trying to find some way of coping with the matter. There are, in fact, many difficult problems to resolve, technical as well as political.

On the technical side there are a number of questions that must be answered. On the question of defining military expenditures, a SIPRI Research Report on "The Meaning and Measurement of Military Expenditure" noted:

"As a general rule aggregate military expenditure is considered to be made up of the following components:

- (1) pay and allowances of military personnel,
- (2) pay of civilian personnel,
- (3) operations and maintenance (O and M),
- (4) procurement,
- (5) research and development (R and D), and
- (6) construction,

In addition, in many or most cases the following activities are also regarded as military expenditure:

- (7) pensions to retired military personnel,
- (8) military aid,
- (9) civil defence
- (10) para-military forces, and
- (11) military aspects of activities that are acknowledged as having a joint civil/military function, for example, space or atomic energy.

By and large it is the expenditure aggregate made up of items 1 to 11 that is evaluated internally and compared internationally. On some grounds, however, this list could be regarded as incomplete. The easiest way of showing this is to consider the concept of a nation's military or war potential. The factors conducive to a viable military posture extend considerably beyond the size and quality of the existing armed forces. These factors include the size and structure of the economy, the quantity and quality of human and national resources and the degree of self-sufficiency in essential commodities."

In addition to the question of the scope and content of military budgets, there are the other complicated questions of the international comparability of all national expenditures, including military, and the relationship between military expenditures and military power and effectiveness.

There is also the question of verification of agreed limitations or reductions although, for the reasons stated above, this may not be as great an obstacle as it has seemed in the past. Variations in the trend of military expenditure in a country may be more significant than occasional changes in the absolute level of expenditures between it and other countries. With the new modern techniques of verification, it would be very difficult to conceal important changes that could have any significant impact on the global balance of power.

While the technical problems are serious, they are not insuperable. The basic political questions are more important. If the superpowers approach the task with a real will to make progress, the study can be successful. If the Americans do not place undue stress on the technical difficulties of ascertaining and verifying exactly what

is included in the Soviet military budget, and if the Russian reluctance to divulge any military information is not carried to the extreme of aborting the study, a beginning can be made for a genuine effort to grapple with the problem of military expenditures and thus with the arms race.

The Secretary-General will report the expert group's study to the forthcoming session of the General Assembly. If the experts can succeed in arriving at agreed conclusions, as has been the case with all of the six previous expert studies in the field of disarmament, including such important ones as the reports on nuclear weapons, on CBW and on the effects of the arms race, their report may become the guideline and basis for further international action.

The results of the study could also help to facilitate some of the longer-term institutional and methodological arrangements suggested in the paper "A New Approach to Comprehensive Disarmament", such as the publication of an official U.N. Armaments Year Book, the international exchange of scientific and technical information that might have important military applications, and the creation of a U.N. Arms Review Committee.

Any steps taken in this direction might help to extricate the nations and peoples of the world from the grotesque predicament in which they now find themselves.

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Pugwack 174

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