27th Pugwash Conference
24-29 August 1977, Munich, Federal Republic of Germany
"Peace and Security in a Changing World"
Agenda

1. Nuclear Arms Control and Disarmament

   a. Dangers to peace and security from the nuclear arms race.
   b. Current status and prospects of SALT.
   c. Problems of nuclear proliferation and diversion of nuclear materials.
   d. Nuclear arms control measures (NPT, CTB, PNE) and security guarantees (nuclear weapon-free zones, no-first-use agreements).
   e. Present concepts of 'military balance' and 'deterrence', and alternatives.
   f. Systematic steps towards GCD.

2. Arms Control and Disarmament in the Non-Nuclear Realm

   a. Impact of the arms race on peace.
   b. Arms trade.
   c. Military expenditures.
   d. The Vienna negotiations on force reductions in Europe.
   e. Progress in control over armaments: military expenditures, CW, new weapons (e.g. environmental warfare).

3. Co-existence, Détente and Cooperation between Nations and Systems

   a. Reducing distrust and tensions between nations.
   b. Status of implementation of the Treaty for Security and Cooperation in Europe.
   c. Problems of free circulation of people and ideas in areas other than Europe.
   d. Vulnerability of societies to disruption (terrorism, technological imperialism).
   e. Strategies for settlement of conflicts without use of force.
   f. Role of the United Nations in alleviating tensions and preventing violence, with special reference to international security forces.
   g. Psychological and behavioural aspects of mistrust and tension between nations.
   h. Current conflicts.

4. Security of Developing Nations

   a. Impact of nuclear arms race.
   b. The Indian Ocean as a Zone of Peace.
   c. Impact of progress of peaceful nuclear energy.
   d. Problem of transfer of military technology.
   e. Growth of military expenditure.
   f. Non-military threats to security of developing nations.
   g. Role of multi-national corporations.

5. Development Problems of the Economically Poor Nations

   a. Self-reliance and international collaboration.
   b. Priorities for the application of science and technology to development.
   c. Achievement of sufficiency in food, health care, and education.
   d. Optimization of energy requirements for development.
   e. Obstacles to reaching social and economic goals defined by the developing nations.
   f. Contribution of Pugwash to the UN Conference on Science and Technology for Development.
   g. Scientific advances needed for development and their potential impact on society.

P.T.O.

6. Energy, World Resources, and Population Trends

   a. Potential alternatives for oil and fission energy.
   b. Non-renewable natural resources.
   c. Distribution of the wealth of the seas.
   d. Population trends.
   e. Prospects for food supplies.
   f. Possibility of defining maxima for consumption.

7. Environmental Hazards of Global Concern

   a. Pollutants and the ecosystem.
   b. Extra-terrestrial modifications.
   c. Disposal of nuclear and other wastes.
   d. International monitoring systems and standards.

8. Science, Scientists and Society

   a. Improving international collaboration in science.
   b. Accountability of science and scientists to the public.
   c. Science and ethics.
   d. Ways of fulfilling the social responsibility of young scientists.
   e. Guidelines for the professional conduct of scientists.

The following have been invited to act as conveners for respective working groups (WG). The first-named convener has been asked to prepare a background document to serve as a basis for discussion in the group, and as a guide for other working papers submitted on individual topics listed above (see item C.3 on Information Circular No. 1).

WG1	Kistiakowsky (USA),	Milstein (USSR)
WG2	Gutteridge (UK),	Lundin (Sweden)
WG3	Dobrosielski (Poland),	Carlton (UK)
WG4	Galal (Egypt),	Sokolov (USSR)
WG5	Wionczek (Mexico),	Hoffmann-Ostenhof (Austria)
WG6	Leibnitz (GDR),	Boulding (USA)
WG7	Smith (Netherlands),	Maaloe (Denmark)
WG8	Udgaonkar (India),	Czaki (Hungary)

Please complete and return to:

Director-General
Central Office
Pugwash Conferences
9 Great Russell Mansions
60 Great Russell Street
London WC1B 3BE
England

27th Pugwash Conference
24-29 August 1977, Munich, Federal Republic of Germany

	Air	Auto	Train
Day of arrival:	☐	☐	☐
Day of departure:	☐	☐	☐

Accompanying persons: . . . . . .

. . . . . .

. . . . . .

Special diet requirements: . . . . . .

. . . . . .

. . . . . .

Choice (or re-confirmation) of Working Group - First choice ☐

Second choice ☐

Name (block letters): . . . . . .

Address: . . . . . .

. . . . . .

. . . . . .

Special Document
27th Conf/P. C. 1

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

ORGANIZATION OF PUGWASH

The preceding quinquennial Conference (22nd, Oxford, 7-12 September 1972) approved the report of the Standing Committee on Organization which dealt with three problems:

1. Structure of the Executive Office, with particular emphasis on the Secretary-Generalship.

2. Structure of the Continuing Committee (now re-named Council) including representation, rotation and selection.

3. Financing of Pugwash.

The above topics are considered in the light of developments during the past five years, and proposals are made on them for the next quinquennium. In addition, the functions of national and regional groups are dealt with.

A. The President

The President shall be selected, as before, from amongst the most eminent scientists and scholars in the world. The President shall preside at one or more plenary sessions of the Pugwash Conferences and may also participate ex officio in the Pugwash Council and Executive Committee meetings.

B. The Director-General (previously termed Secretary-General)

The Director-General (DG) shall be an active scientist of high stature, and shall serve as the chief executive officer of Pugwash. The DG shall:

1. Carry out decisions of the Pugwash Council and Executive Committee. The DG shall participate ex officio in their meetings.

2. Be responsible for the organization and preparation of Pugwash Conferences, Symposia and Workshops, and for Pugwash publications.

3. Manage Pugwash finances.

4. Represent Council in Pugwash Symposia and Workshops as well as in relations with national and international organizations.

5. Report on Pugwash activities and Council proposals to the Annual Conference.

C. The Council

Pugwash Council (PC) is the main policy-making body of Pugwash. In performing this function the PC shall follow the decisions of the quinquennial Conference. It shall elect its own Chairman. The PC shall approve topics and agenda of Pugwash Conferences, Symposia and Workshops, as well as the geographic distribution for participants to these meetings. The PC shall decide on such policy matters as publications and finances, and may at its discretion appoint sub-committees or otherwise delegate authority to carry out the necessary tasks.

The Council shall elect and arrange terms of appointment with respect to the President, Director-General, and members of the Executive Committee, in accordance with decisions adopted by the preceding quinquennial Conference.

The Council shall consist of prominent scientists and scholars of high reputation in their own as well as in foreign countries. Profiles of Council members shall be published in the Newsletter.

Nominations for Council members shall be made by the national or regional Pugwash group (wherever they exist) in the following constituencies:*

Constituency	Seats	Countries or Regions
I	3	United States of America
II	3	Union of Soviet Socialist Republics
III	2	United Kingdom
IV	3	Countries in Europe other than those in constituencies II, III, V and VI, plus Australia, Canada, Israel and New Zealand
V	3	Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania
VI	1	Austria, Finland, Sweden, Switzerland, Yugoslavia
VII	2	Asia (with the exception of China)**
VIII	2	Africa and the Middle East, covering the area of the United Nations Regional Commission, except Israel.
IX	2	Latin America
X	up to 2	Co-optable by Council.

The Council shall use its powers to co-opt in order to meet special needs or situations, and especially to obtain a balance in its composition in respect of scientific disciplines, age and sex. In addition, former Secretary-Generals of Pugwash shall be invited to serve on the Council.

Election of Council members shall be made by the following procedure:

a. The members of Council to serve during the next five-year period shall be elected according to the above composition, at the quinquennial Conference.

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* The outgoing Council recommends that the question of constituencies and number of seats in them be reviewed by the new Council.

** Appropriate provision will be made for China upon their return to Pugwash.

b. Vacancies occurring between quinquennial Conferences shall be filled in the following way. National or regional groups from the constituencies where the vacancy has arisen shall be requested by the Director-General to submit nominations. If the number of nominations exceeds the number of vacancies, the election shall be made by majority vote of the national or regional groups in the constituency. For those constituencies in which there are no national or regional groups, vacancies shall be filled by the Pugwash Council.

The Council shall normally meet annually at the time of the Pugwash Conference.

D. The Executive Committee

The Executive Committee shall be responsible to the Council for implementing the policies approved by Council and the decisions concerning details of organization. It shall consist of the Chairman of the Council and the Director-General ex officio, and of a maximum of seven individuals selected by the Council from amongst its members. The Executive Committee shall elect its Chairman.

The Executive Committee shall meet as needed between Council sessions. It shall report on its activities to the next meeting of the Council.

E. National or Regional Groups

The Director-General shall attempt to establish and develop National or Regional Groups where they do not already exist, and to promote activities of existing groups, keeping in mind the need to increase the participation of young scientists. He shall undertake this task in close consultation with the members of the Council from the constituencies concerned. The National Groups shall have full autonomy concerning their organizational structure.

National or Regional Groups shall:

1. Promote Pugwash activities in their respective countries, such as convening national Symposia, Workshops and other meetings, and the dissemination of information to the scientific community and general public.

2. Nominate participants to the Annual Conferences, and provide, whenever possible, their travel costs.

3. Nominate to the Director-General qualified participants for international Pugwash Symposia and Workshops which have been approved by the Council or Executive Committee. Invitations to such international Symposia or Workshops shall be made by the Director-General in consultation with the National Groups and the host country of such meetings.

4. Arrange for annual contributions towards expenses of the activities of the Central Pugwash Office.

F. Finances

The Council shall decide upon the amount to be paid by National or Regional Groups towards the expenses involved in carrying out the functions of the Pugwash secretariat. The Council shall determine whatever procedures and mechanisms are necessary for the raising of adequate funds to ensure the efficient execution of Pugwash activities.

Special Document
27th Conf/P. C. 2

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

THE MODALITIES OF PUGWASH ACTIVITIES

1. Preamble

The choice of the type of activity to be undertaken by Pugwash is directly linked with the question to whom we should address ourselves: governments, the scientific community, or the public at large. This dilemma faced Pugwash in its earliest days. It was then agreed that the main task of Pugwash was to help governments in shaping their policies on matters of world security; this decided the main type of Pugwash activity, to which we have adhered ever since, namely, small private meetings. However, with the change in the world situation that has occurred over the years, and the accompanying shifts in emphasis of Pugwash topics, there have been increasing calls for more openness in Pugwash, for a greater effort to educate the public, and even to influence public opinion directly.

While recognizing the force and aptness of these arguments, we must avoid going from one extreme to another; we have to be careful not to turn Pugwash into a mass movement. Instead of making a choice between two divergent aims, we should attempt to pursue both, even though this may present some difficulties.

In this connection it is useful to remind ourselves - and to reaffirm - the main and unique characteristics of Pugwash, i.e. that it is a movement of scientists, and that those participating in our activities do so as individuals, without any commitment to or brief from anybody.

The greatest value of Pugwash as a movement of scientists is that it brings together persons distinguished for their intellectual powers. Coming from different backgrounds, they are capable not only of producing original ideas, but also of listening to arguments of others, of being convinced by them, or coming to respect the holders of views and values with which they disagree.

In an atmosphere conducive for the cross-fertilization of ideas this may lead to the generation of new ways of thinking and to new methods of approach to world problems. Such an atmosphere can only be created in small conferences or symposia, held in private, with the participants able to speak frankly and without inhibition. This traditional type of Pugwash activity should, therefore, continue to have top priority.

However, good scientists are usually also good educators. We should exploit this and attempt to involve Pugwash scientists in activities - meetings and publications - specifically aimed at educating other scientists, students, science writers, and occasionally the general public. To achieve this a much greater effort than hitherto will have to be devoted by Pugwash to this type of activity, and this we recommend.

2. Annual Conferences

These should continue to be the major Pugwash activity. The Annual Conferences offer the opportunity for a larger number of Pugwashites to meet, but although the social contacts and informal talks are in themselves valuable in furthering the aims of Pugwash, the provision of a forum for advanced and creative thinking, as outlined in the preamble, is still the most important task of the Annual Conferences. But to achieve this, great care is required in the selection of participants, and

much more preparation of the programme than hitherto.

There are two main objectives of the Annual Conferences. One is to review and analyse critically the activities during the past year of Pugwash itself, as well as of other international organizations which are concerned with problems of interest to Pugwash; this task is best performed in plenary sessions. The second is to conduct original discussions - based on invited or profferred papers - on selected topics; these discussions are best held in Working Groups, which should be sufficiently small for the discussants to sit round a table. Not all topics of interest to Pugwash need to be covered at every Annual Conference. The selection of topics will partly depend on the venue of the Conference (for example, greater emphasis than usual should be given to problems of development if the Conference is held in one of the developing countries), but primarily it should be determined by the weight of the contribution that Pugwash can make. We should take up a topic only if we have something to say on it, and not because we feel we ought to say something. If the preparation of the agenda could begin two conferences ahead, this would ensure a better balance, as well as a better standard of preparation.

The submission of a paper should not be a condition for participating in a Conference; on the other hand, papers submitted should be original, i.e. have not been published elsewhere, their scientific contexts should be of a standard expected in a scientific journal, and must be sent in early enough for editing and pre-circulation. In any case, abstracts of papers should be sent in well in advance to enable conveners of Working Groups to structure the agenda early, and not to leave this to the last minute. The participants in a given Working Group should be familiar with all previous Pugwash discussions on the topic, so as to avoid waste of time and repetition.

Reports from the Working Groups are generally intended for the record and for the information of Pugwashites only; therefore, not too much time should be spent on their writing. The present system of reading out the Reports at plenary sessions, although wasteful of time, should continue, as it enables members from the other Working Groups to make comments; these have often been very valuable.

3. Symposia

These provide a greater opportunity than is available at the Annual Conferences to discuss a specific subject in more detail. Indeed, Symposia were instituted for this purpose, to study a well-defined topic in depth. For this reason, participants in Symposia should be selected on grounds of expertise in the topic rather than by geographic considerations.

The initiative for organizing an international Pugwash Symposium rests with the National Group in the host country, but before approving it the Pugwash Council should satisfy itself that the conditions to ensure a high standard of the Symposium will be met; no approval should be given for a Symposium if the topic is diffuse, or if the participation of a sufficient number of experts cannot be guaranteed. Apart from this, the considerations with regard to number of participants, submission of papers, privacy of meetings, that govern the discussions in Working Groups at Annual Conferences, apply also to Symposia.

4. Workshops

These differ from Symposia in two ways: (a) they have a smaller number of

participants (10-20 instead of 30-40); and (b) they deal with a topic of a recurring interest which requires a series of meetings. An example is the series of Workshops on Chemical Warfare. Workshops have taken the place of the earlier Study Groups, which also provided a continued effort, but became unwieldy when they grew too large; this mistake should be avoided in the future. The organization of Workshops should be in the hands of a small group of experts.

The findings of Workshops are often of immediate interest to U.N. or other international organizations; a mechanism should be evolved for the direct transmission of reports from Workshops to these bodies.

5. Open Meetings

The three kinds of activity listed so far are all of the traditional Pugwash type, i.e. closed meetings with participation by individual invitation only, and they have an international character. As mentioned in the preamble, there is a growing need for more open activities, and Pugwash should concentrate on these to a larger extent than up to now.

The aim of these meetings would be either to explain to wide audiences about Pugwash itself, what it stands for and what it is doing; or to provide a forum for discussion - in the presence of a large gathering - between scientists themselves, or between scientists and politicians, on some topic of importance to Pugwash. The meetings could also aim simply at educating the public, by lectures, on subjects within the range of Pugwash interests.

The type, topic and audience at such meetings as well as the responsibility for their organization would vary according to circumstances. Open meetings may be organized by National Pugwash Groups in their own names but with advice and assistance from the Central Office, when called for. Or, they may be held in the name of the international Pugwash Movement, in which case they will be planned and organized by the Council, Executive Committee and Director-General in conjunction with the National Pugwash Group or Groups concerned.

A suitable opportunity would be the occasion of an Annual Conference or a Symposium in a given country. Some of the participants would be invited to address public meetings. A good example of this was the public lectures organized in Kyoto and Tokyo after the Kyoto Symposium in 1975; these lectures attracted large audiences and received good publicity for Pugwash in the Japanese Press and TV.

Another possibility is a Pugwash forum at meetings organized by other bodies. An illustration of this is the International Youth Science Fortnight, held annually in London for some 500 young scientists from many countries. An arrangement has been made with the organizers to devote one day to a discussion on Pugwash, led by a number of Pugwashites from several countries.

Clearly, there are many ways in which Pugwash could come into contact with wider audiences, and National Pugwash Groups should be encouraged to explore them, and to report their efforts in the Pugwash Newsletter, so that other Groups could learn from their experiences.

6. Publications

Another form of educating or influencing wider audiences is by publications. The present Pugwash publications, the quarterly Newsletter and the Proceedings

of Conferences, are closed publications, and primarily intended to keep Pugwashites informed of our activities. The publications intended for the general public are the Conference Statements and Symposia Monographs.

The Public Statements issued by Council after every Conference are very carefully worded and a great effort goes into their drafting, but they receive hardly any publicity. They serve indeed much more as a summary of the Conference for the benefit of other Pugwashites than as information for the general public. These realities should be recognized. The present type of document should continue to be prepared by Council, but as a summary instead of as a public statement. On the other hand, when a Conference comes up with an idea which could have a public impact, and if Council considers it desirable that it should be brought to the notice of the public, then a special effort should be made to give it the widest publicity. For the sake of preserving the high reputation of Pugwash, only Council - or a body designated by it - should be authorized to issue public statements on behalf of the Movement.

The Monographs of Symposia are in the nature of scientific publications and can contribute significantly to the enlightenment of the scientific community or society in general on a particular subject. If the standards of Symposia are kept high, then each Symposium could provide material for a Monograph, and this should be our aim. If publishers could be found to issue them promptly, then the Pugwash series of Monographs, with some three volumes each year, could become a major factor in the objective of Pugwash to educate and inform the public.

Should the financial situation permit it, Council should be encouraged to explore the possibility of starting an open Pugwash Journal which could contain selected papers from Pugwash Conferences, public lectures, as well as material specially written for the Journal.

Special Document
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27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

STATEMENT OF PRINCIPLES FOR THE PUGWASH MOVEMENT

Twenty years ago, in July 1957, a group of scientists from East and West met in the Canadian village of Pugwash, to discuss the threat to mankind produced by the advent of hydrogen bombs. This was the birth of the Pugwash Movement, conceived in the Manifesto issued in 1955 by Bertrand Russell, Albert Einstein and nine other eminent scientists, calling on scientists to assemble in order to appraise the new peril, and urging Governments to renounce wars and seek peaceful means for the settlement of disputes.

By now, through the annual Conferences, Symposia and Workshops, over a thousand scientists have participated as individuals, in the world-wide Pugwash Movement. The characteristic feature of Pugwash discussions - open-minded and free exchanges among scientists from all parts of the world, irrespective of ideology or political commitment - very soon resulted in a broad consensus on the main issues and fundamental facts of the world situation.

There has been progress during the last two decades toward international acceptance of measures to control the growth and spread of nuclear armaments: the partial Test Ban Treaty of 1963; the Nuclear Non-Proliferation Treaty of 1968; the Conventions banning the emplacement of nuclear weapons in space (1967) and on the sea beds (1971), the Treaty on Anti-Ballistic Missile Systems (1972), and other arrangements arrived at in the Strategic Arms Limitation Talks. These measures of nuclear arms control have helped to decrease tensions, to lessen the danger of nuclear war and to strengthen the atmosphere of détente among nations. The Final Act of the Helsinki Conference on European Security and Cooperation (1975) has opened the prospect that Europe will never again be the epicentre of a world-wide conflagration. The Convention Banning the Development, Manufacture and Stockpiling of Biological Weapons (1972) stands as an example of the possibility of agreement to eliminate weapons of mass destruction. In these achievements Pugwash played an active role.

But these steps are far from enough to remove from the world the desperate danger of nuclear annihilation. The arms races continue, and even intensify, both in nuclear and in so-called conventional weapons. Our goal of comprehensive disarmament seems ever further way as nations continue to rely on military force in seeking solutions to their differences.

In the past twenty years science and technology have made new strides which, if properly applied, could have contributed enormously to providing the basic requirements of food, clothing, health and housing for all, and to increasing both material and spiritual well-being. Instead, vast scientific efforts and technological resources are diverted toward destructive applications, involving tremendous human and material wastes. Nuclear arsenals grow with ever increasing sophistication of weapons and means of delivery. More and more nations are acquiring the capability of making nuclear weapons. New forms of mass killing are being invented all the time. Vitally needed resources are squandered by all nations in the accumulation of armaments of greater and greater lethality. With each passing day, the earth is an ever more endangered planet.

In these circumstances, the goals to which Pugwash efforts have been directed in the past should continue to command our unwavering support.

The main preoccupation of Pugwash remains with problems of disarmament and related issues of international security. High priority should continue to be devoted to the relationship of scientific and technological cooperation among all nations to world peace; in other words to the links between peace, disarmament and development.

There must be a renewal of efforts to stop the arms race, to reduce and, indeed, to eliminate all nuclear weapons, rather than just to control their proliferation. New weapons and means of warfare, based on new technological advances, must be nipped in the bud. Towards these ends, advantage must be taken of every opportunity to remove the root-causes of distrust, conflict and war, to increase the awareness of common interests among nations, and to advance the causes of disarmament and peace.

One great advance of the last twenty years has been the replacement of the "cold war", between the nations of the east and the west, by a recognition of the necessity for peaceful coexistence and cooperation, known as détente. Détente should be made irreversible and, by incorporating into the fabric of international relations, extended to all regions of the world. An alternative must be found to reliance on nuclear deterrence, based on the concept of assured mutual destruction, as the means of preserving peace. Insidious new doctrines of "partial", "limited" or "acceptable" nuclear war must be decisively rejected, and replaced by positive measures for promoting cooperation and peace through international order. Means must be devised for bringing an end to the world-wide expansion and competition in military research and development, which continues to fuel the arms race and to frustrate our attempts at arms control. Scientists have a special responsibility for this aspect of the arms race.

We must also continue to work towards removing the forces responsible for the great and growing disparities between the highly industrialized and the developing countries. Starvation and misery remain the norm for a very large part of the world's population. The resources of the world are being wasted with little regard either for present inequities or future needs. This grim situation is incompatible with the achievement of a just and humane world order, and endangers world peace.

Pugwash welcomes the increasing involvement of third-world scientists in all aspects of its work. Scientists from all nations must continue, together, to explore the contributions that science and technology can make to the establishment of an equitable economic, social and political world order. Towards this end, we need to investigate such questions as ways of increasing the commitment by richer nations to accelerate the independent, self-reliant development of the poorer; reduction of pressure to increase the level of armaments in the third world; elimination of military and non-military threats to the independence and security of developing nations; adoption of measures to assure the responsible and equitable distribution of world resources; effective means for fostering

the scientific and technological capability of the underdeveloped world.

Progress on development issues and in the reconstruction of international economic relations on a just and democratic basis will help to strengthen détente and solve problems of disarmament. Equally, the amelioration of the international climate and improvement of international security will allow states to use for development purposes a growing part of the vast resources now squandered on arms and the military. Thus the Pugwash themes of disarmament and development are linked as essential elements of the larger effort for a world at peace.

International cooperation between scientists and technologists is an increasingly important factor in solving the world's problems. Therefore, we take this occasion once again to call on the scientific community - and indeed on all persons of good will - to be actively engaged in safeguarding the future of mankind, which is still in danger.

On entering into the third decade of Pugwash, the summons of the Einstein-Russell Manifesto retains its original urgency. "We must learn to think in a new way", they said, when they first called us together. "We are speaking on this occasion, not as members of this or that nation, continent or creed, but as human beings, members of the species Man, whose continued existence is in doubt...".

While we are confident that it is possible to build a world without war, with all nations sharing in the riches of the earth and the assets of the human mind, we realize that this will not be achieved without a tremendous, dedicated, united and sustained effort of men and women of different origins, ideologies and political views.

In the end, humankind can only be saved by human actions. We all bear responsibility for the preservation of the civilization of which we are the human heritors, and its improvement for those who will come after us. As scientists we share heavily in this responsibility. Science must be used only for the benefit of humankind - never for its destruction.

This document has been specially prepared by Professor Leibnitz as convener of Working Group 6. It is intended to serve as a basis for discussion by the Working Group in Munich, and for working papers submitted by participants. The latter should not exceed 10 double-spaced typewritten pages, plus a 250 word abstract for possible publication in the Pugwash Newsletter.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

E. Leibnitz (GDR) XXVII-26

ENERGY, WORLD RESOURCES AND POPULATION TRENDS

Introduction

Since the Pugwash Conferences in Oxford, Aulanko, Baden, Madras and Mühlhausen, an immense number of publications have come out quoting such a host of figures that it is practically impossible to give even a survey as to quality and quantity in the following. One also has to bear in mind that the publications are contradictory to some extent. Figures can differ by as much as 100 per cent. Often the author's own position is decisive for the way the article has been written.

Therefore, an attempt has been made in the following to write down the essential problems which appear in almost all publications, as a background paper, without attempting to evaluate them. This should be left to the discussion in the working group. I have tried to show where the problems necessarily overlap with the work of other groups.

It is necessary to point out that the host of open questions demands that the working group strive for a rather concise debate if a substantial report is to be compiled.

(a) Potential alternatives for oil and fission energy

The production and distribution of electrical energy still ranks first. Though it is generally acknowledged that a satisfactory state may be reached, statements differ widely as to the time as well as to the per capita output to be attained.

Differences between the highly industrialized and the economically less developed countries have grown. The rates of growth in installed electrical power differ among the industrialized countries too, but this is of no importance as compared to the less developed countries. It is generally emphasized that there is no equivalent to electrical energy as useful energy. Only natural gas can be distributed similarly easy and transformed at the place of use.

Where high-capacity power stations are concerned, the only alternatives to oil and fission energy in the near and medium-range future are the fossil fuels, hard coal and lignite. Non-uniform distribution of the deposits, higher expenditures for opening up the deposits and mining, transport of solid matter instead of liquids, and higher investments for power stations in keeping with the necessary protection of the environment are widely mentioned to underline the advantages of nuclear power stations. In addition to the political and economic questions raised in working groups 1 (c), 4(c) and 7(c), other important questions are still insufficiently clear for the building of nuclear power stations. This applies to breeder reactors and probably to a still higher extent to a

technology for nuclear fusion.

Hydro-electric power stations may be regarded as applicable for the production of electrical energy to a considerable degree, as the adequate generators and driving engines have reached high technical perfection. However, they cannot be considered a global alternative because of the very high investments necessary, the expensive distribution equipment, and limited sites. The percentage of share in world energy production will scarcely undergo notable changes.

There have been further experiments with the use of sun and wind for energy, but they cannot be recognized as genuine alternatives for the production of electrical energy at the present state of development. Storage of such energy must be regarded as unsolved for the near future.

There exist, however, manifold possibilities already now for relieving the distribution network of electrical energy and/or gas.

If corresponding small plants can be supplied in a foreseeable future at reasonable prices, they could gain in importance for agriculture in the economically less developed countries, particularly for the supply of water.

Use of geo-thermal energy has made only little progress. Particularly, the possibility of gaining heat from igneous rock has scarcely been investigated.

Insofar as transport is not dependent on electrical energy, hydrogenation of coal can be considered a genuine alternative which might become competitive in the near and medium-range future on account of the rises in oil prices to be expected. The same applies to gasifying coal when the working of natural gas diminishes or stops.

(b) Non-renewable resources

Under this heading all minerals must be considered, the fossil fuels, but also to a certain extent the oceans and the atmosphere.

Written statements widely differ in estimating world resources in the various useful minerals. There is, however, far-reaching agreement with regard to two problems. Further exploration of the lithosphere, also in great depth, will lead to the discovery of new deposits in decades to come. But it has to be expected that also poorer deposits must be brought to production to cover world-wide demands in raw materials. This will require new technologies which are in no way mature so far. Therefore, higher expenditure for mining, processing and working must be taken into account.

In addition it is a fact that regarding the non-uniform distribution of deposits, a considerable share in the important mineral resources occurs in the economically less or almost non-developed countries. As is known, the Paris Conference, i.e. the so-called North-South Dialogue, which lasted over one-and-a-half years, could not at all remove

the economic and consequently political tensions resulting from this fact. Obviously a global management of non-renewable resources cannot be expected even in the far future, though seen from the angle of economic growth a common use would be desirable soon.

Analogous conditions prevail in the case of fossil fuels. Hard coal, however, is distributed in such a way that the industrially highly developed countries are in control of the essential deposits. But the main resources of mineral oil have a similarly unfavourable location.

The present rate of growth in finding new deposits and the growth in exploiting them allow for the statement that the oil fields might be already exhausted in a medium-range future, while gas deposits could be somewhat richer.

There are most extensive reserves in hard coal. Lignite has been explored only in part so far, and the deposits could, when thoroughly explored, reach at least the size of the hard coal resources.

The oceans, too, must be rated among the non-renewable resources. This would include the results achieved in the working group 7 under (a).

The entire section is closely connected with the topics of working group 5.

(c) Distribution of the wealth of the seas

The present situation is characterized by the fact that manifold complications of an economic and political nature may result from the negotiations on a new international Law of the Sea not yet having been resolved. The extension of the sovereign rights of the countries bordering the oceans to 200 miles has led to rather complicated conditions already, and the current talks have not at all led to satisfactory results.

The situation of the countries with no immediate access to the oceans has become far more complicated as well. They will have to spend considerably more now when seeking to have a share in exploiting the seas.

On the other hand the biology of the sea leaves open a vast field of research in spite of great efforts already made. There is, for instance, the still inexplicable migration of fish, the knowledge of which will constantly grow in importance with the extension of sovereign rights. The increasing interest in catching and working the mico-crustacea must be added.

Great progress has been made in the technological development of hoisting the mineral resources even from considerable depths of the sea. But the rights of hoisting are also insufficiently clear in connection with the new Law of the Sea.

In certain fields (oil and gas haulage) obviously technical safety does not reach the same standards as the haulage output. Large-scale damage could be prevented, but this

cannot be taken for granted for the near or more distant future. Corresponding problems again fall into the competence of working group 7 (a).

d. Population trends

As a whole, the increase in population is obviously going on at a considerable rate.

But regionally special features are developing. Economically highly developed countries report a very low increase, stagnation or even a decline. Medical means of family planning and their legal use do not suffice to explain this fact. The sociological influence of the high state of economic development cannot yet be called sufficiently investigated. Socio-political effects, however, may be quite serious.

Traditional and ideological prejudice against family planning is still most effective. In a number of cases it became evident that a change of government, even of vast countries, when including such factors in domestic policies, might not only stop demographic measures already under way, but even completely cancel them.

In general the situation is still alarming. It has to be realized in particular that the highest increases in population occur where economic progress is especially slow.

(e) Prospects for food supplies

When discussing this problem, one should start from the fact that developments in agriculture in practically all economically highly developed countries keep in pace with the development of industrial goods production, and often considerably surpass the demand.

This implies that much knowledge is available, the world-wide application of which would create the conditions necessary for sufficiently feeding even an increasing population. Among the essential factors let us consider, in addition to the training of experts for the transition to a widely industrialized vegetable and animal production, of the supply of water, fertilizers, pesticides and technical equipment as well as of the infrastructure leading to the cultivated areas. Relations to the questions discussed under (a) are obvious. The great difficulties arising when it comes to investments known and necessary are well-known too.

If practicable solutions have been found, the production of the required quantities of carbohydrates and fats may be regarded as widely assured.

Considerable efforts have been made to close the protein gap still existing, particularly in the feeding of animals. They concern the industrial production of biomass rich in protein from cheap starting materials, as well as to preliminary studies for the use of the oceanic micro-fauna.

Everywhere research for improving seeds by cultivation and animals by breeding

has been embarked upon to a considerable extent, promising essential improvements.

The farming of sea-mammals seems to become a further possibility of extending the food basis in the more distant future.

As far as help is rendered by the economically highly developed countries to the less developed countries, the encouragement of agriculture and the economic branches serving it does not seem to have always the necessary priority. Often economic aid is preferably given to those territories where those giving the assistance have an immediate interest in the results.

(f) Possibility of defining maxima for consumption

Here the opinion is held that discussion will be very difficult without special preliminary studies being made on the problem. The necessity of clarifying pertinent questions is shown by the problems under (a) to (e).

Useful background is at present only presented by the statistics of some economically highly developed countries. They all, however, draw the per capita data from a simple division of the consumption arrived at by addition during a calendar year. But an asymmetric distribution still prevails within the respective population that is determined by the individual economic conditions as well as by local habits and climatic conditions.

It is necessary to establish the scientific foundations which have to be made available to approach such an important factor.

An attempt should also be made to bring to prominence such fields of the production of goods and services where certain limiting values are becoming evident.

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M. Innas Ali (Bangladesh) XXVII-27

INTERNATIONAL COOPERATION IN BUILDING SCIENCE AND TECHNOLOGY INFRA-STRUCTURE IN THE LESS DEVELOPED COUNTRIES

INTRODUCTION

International scientific co-operation related to the Less Developed Countries (LDCs) began in the early 1950s. During the 50s it was hardly conspicuous; only a very few LDCs which already had some science and technology could get the feel of it. The 1960s were a period of international conferences, workshops, symposia, etc. which created in a general way awareness among the LDCs of the importance of science and technology for their socio-economic development. The 1970s were expected to be a decade of action for actual development of science and technology in LDCs. Unfortunately those expectations have proved completely futile. Except for a very few countries which seem to have taken off toward self-propelled scientific development, the LDCs continue to struggle with their problem as they did in the 60s. International assistance aimed at promoting and accelerating science development is as inadequate in quantity, quality and effectiveness as it was in the 1960s.

Scientific co-operation during the 60s and 70s was directed mainly by the Developed Countries (DCs) and operated through formal bilateral or multilateral agreements between governments and or international/regional organizations. It was primarily characterised by dependance of an individual LDCs on the respective donor DC. Its main limitation was that it neglected building of scientific infra-structure in an LDC in favour of specific projects which assumed the existance of such an infra-structure.

No doubt, the aim of international scientific co-operation should be catalylic action but its contact points must be strategically chosen so that small amounts of international assistance can stimulate large amounts of indigenous activity in the proper direction. For this an LDC must have significant understanding of the mechanism of scientific and technological development and establish a viable infra-structure that will support it. Hence international scientific co-operation must begin with building of this infra-structure in the LDCs.

It is gratifying that the main objective of the proposed 2nd UN Conference on Science and Technology is to provide instruments of international co-operation to LDCs in strengthening their scientific and technological infra-structure. The Conference also proposes to deliberate and take decisions on co-operation in solving specific socio-economic problems of the LDCs in accordance with their national priorities, that cannot be solved by individual action. Pugwash has a role to play particularly in providing background papers for this conference. The 27th Pugwash Conference is expected to contribute a substantial part of these background papers. This paper has been prepared on this understanding and an attempt has been made here to present a realistic approach on "International Scientific Co-operation" keeping in view the primary requirements of the LDCs.

SCIENTIFIC AND TECHNOLOGICAL INFRA-STRUCTURE IN LDCs

Only a few of the LDCs have built up viable national infra-structures and acquired scientific and technological capability; a few more are perhaps on the threshold of such development; but the bulk of the LDCs are still very much in their initial stages of development having only some fragments of scientific communities and institutions.

International co-operation related to the threshold countries should be directed to their specific needs as felt and perceived by them; but the main stress must be put on the later countries which need international co-operation in a general way for building the essential components of scientific and technological infra-structure. These components are : (1) Policy and Organization, (2) Education and Manpower (3) Research and Development and (4) Information & Documentation. They are very much inter-related and there must be balanced growth of these components for building a viable scientific and technological infra-structure.

Policy and Organization

Unesco during the last two decades deliberated quite intensively on science policy and organization and provided valuable guidelines for the benefit of its Member States. This assisted most of the LDCs in setting up institutions for science policy and organization. Unfortunately those institutions generally remained very weak and ineffective in the later group of LDCs and they were unable to make any significant change in the situation. The proposed instruments of international co-operation must ensure strengthening of these institutions which generally consist of two types of organs, namely (a) policy-making, planning and decision-making organs and (b) executive organs consisting of national executive agencies and scientific institutions. International co-operation in particular should assist the policy-making and planning organ in performing specific functions such as :-

(a) establishment of Data Base in an individual LDC on scientific and technological potential such as manpower, physical facilities, finance, management, natural resources, transfer of technology, indigenous skill, scientific and technological capability, etc.

(b) organization and financing for science and technology development;

(c) priority assessment in Research and Manpower Development;

(d) holding workshops on science and technology policy and planning;

(e) preparation of a national science and technology plan;

(f) evaluation and coordination of scientific and technological activities and utilization of results in the development sector.

The executive organs generally consist of sectorial councils, universities, government departments and the network of educational, training, research and supporting scientific institutions which form the material and intellectual base for development of scientific and technical manpower and other scientific and technological activities including research and development. International co-operation related to them is discussed in the follows sections.

Education & Manpower Development

The LDCs mentioned above need effective systems of education and training to build up their scientific and technical manpower which must include, (1) high level specialists in different branches of science and technology and (2) auxiliary personnel such as technicians, librarians, computing personnel etc. International co-operation must stimulate indigenous activities in building up of a high quality, substantial system of scientific and technical education well matched to local conditions as well as to the world wide scientific community. In this context the co-operation programme should specifically include:-

(1) Creation of new and reform of existing educational and training institutions.

(2) Improvement of carricula and innovation of teaching and training methodology and examination systems so as to make the entire education and training system most functional in the context of national needs and aspirations.

(3) Provision of primary resources of education and training, namely - qualified teachers, physical facilities and equipment, books, journals, teaching aids etc.

(4) Maintenance of international standards and healthy academic atmosphere.

In the whole system narrow specialization and non-functional understanding of science must be avoided. Scientists with a non-functional understanding of science and an extremely narrow area of competence are virtually useless from the stand point of scientific productivity and its connections with technological developments. The system in general should be highly oriented towards applied and experimental work and particular attention must be given to education and training of technicians at both secondary and intermediate levels. Attention should also be given to training in science policy and management. In the countries, where the scientific community is still very small, and the infra-structure is still being formed, a substantial fraction of scientists must be concerned with science policy and management activities.

Many LDCs do not yet have an indigenous system of higher science and technical education and have to send their students to the DCs for higher academic degree or training. This has created a host of problems particularly the so called "brain-drain". After a few years they are supposed to return to their own countries and utilize their knowledge and experience acquired abroad for development of their countries. It has now been found that many of them do not return and are lost to their own countries. Moreover the kind of knowledge and skills which they acquire abroad is often not relevant to the LDCs and hence even those who do return to their home countries they cannot significantly contribute to development there. International co-operation should aim at improving the standard of higher education in the LDCs and particularly assist in the organization of post-graduate training and research by supplying physical facilities and equipment and also senior and junior scientists from DCs to the universities in LDCs. The idea is to make proper arrangements for higher training and research in the LDCs themselves so as to enable them to train their high level personnel in their own countries.

Research & Development

A country must first set up proper institutions for science policy, organization, education and training, as mentioned above, before it can enter into a meaningful programme of research and development. However, institutions for research and development and supporting services take considerable time to bring them to a functional level and hence they should also be simultaneously started. In an LDC, R&D must be directed towards adapting and increasing scientific and technical knowledge for its effective incorporation into the production system and for this, along with R&D provision must also be made for supporting activities, namely, economic and technical feasibility studies pilot plant/extension studies, development design, tooling, first production and marketing of the product. For a country in the early stage of development, where scientific and technical personnel are very much limited, and the production structure is primitive, the major role of research and development must be to select and adapt existing scientific and technological knowledge to meet specific local needs and to augment existing knowledge in fields of potential economic relevance, with particular emphasis on those areas which are not or cannot be properly studied elsewhere, as in relation to specific agricultural, biological, water or mineral resources, climatic and soil conditions or special problems of appropriate technologies, energy or rural development. In all these emphasis must be given on applied research and development, but some amount of fundamental research perhaps not more than 20% of the total efforts, is also necessary for generating vitality of science as a whole in the country.

In most of the LDCs under review research activities are still very weak, critical mass is not available and the indigenous scientific community consists mainly of in-experienced researchers with a lack of leadership and direction. Under the existing production structure and economic environment industry in these countries does not make much direct contribution to R&D. Scientific research, if any, is usually carried out in universities and research institutes financed by the government. There is a strong trend to sacrifice quality in these institutes for the sake of quantity and various other considerations. International co-operation should aim at assisting these countries building the scientific morale, raising the standard and fulfilling the above objectives in general and in particular it should be directed to the following:-

(a) organization and financing of R&D and associated supporting facilities

(b) training of young researchers and supporting personnel

(c) establishment of new national institutes and strengthening of the existing ones particularly for R&D, innovation and diffusion in selected areas of vital economic importance, in accordance with national priorities.

(d) supply of equipment and spare parts and competent scientists and technologists

(e) development of a national centre for scientific & technical information and documentation

(f) establishment of international regional institutes in the LDCs.

The main stress of international cooperation in this respect should be aimed at stimulating indigenous efforts in building operational net-works of institutions for R&D, innovation and diffusion in the selected areas.

The LDCs concerned have embarked on the first stage of industrialization depending heavily on import of technical know-how, equipment and industrial material which they do not yet produce. Their main source of income are still agricultural products and mineral exports and hence in general terms it may be suggested that R&D efforts in the following lines may make an impact on their social and economic development:-

(i) Research and scientific inventories aimed at the development of agriculture, food technology, stock breeding and fisheries

(ii) research and scientific inventories directed towards exploiting natural resources in the soil and sub-soil and agricultural raw materials.

(iii) research with a view to the expansion of the basic chemical industry and industries which produce semi-processed goods.

(iv) developmental research designed to promote the expansion of consumer industries

(v) research in fuel and energy

(vi) research in the sector of construction

(vii) research in the sector of health, nutrition and family welfare

(viii) research and scientific inventories for development of appropriate technologies in rural areas.

Information & Documentation

Most of the LDCs do not have well developed information systems. International Scientific Co-operation in this field is urgently needed and this should be directed to building and strengthening the physical structures and organisations for the national information and documentation systems which would include:

(a) Libraries;

(b) Networks of information and Documentation centres;

(c) Production of books and journals;

(d) Printing & Publications

(e) Translation services

(f) Micro-filming;

(g) Use of computers in handling, retrieving and disseminating scientific and technical information and data processing.

(h) Training.

The information system must ensure timely supply of the latest information having direct relevance to the works of the Scientists and Technologists in an LDC and provide written scientific communications among them as well as between them and those in other countries of the world.

In addition, it should provide adequate information to the decision makers on the various facts of Science & Technology management so that they can plan integrated development programme and effectively promote co-ordination among the agencies carrying out these programmes. The information system should also provide for continuous surveys and studies to update the national data base on scientific and technological potential and help continuous evaluation of existing national science and technology policies and formulation of new policies.

Besides providing assistance in building the national structure and organisation for the information system in the LDCs, international scientific co-operation must also facilitate free and unrestricted exchange of scientific and technological information and experience significant to development among the LDCs themselves and particularly between the DCs and the LDCs.

I have discussed above in simple terms the basic needs of the LDCs for building their science and technology infra-structures. The plan and programme of international scientific co-operation which are expected to be evolved in the UN Conference on Science and Technology must be oriented towards meeting these needs as the first step in providing assistance to the LDCs.

I also wish to stress on R&D in the industrialized countries in problems of importance to LDCs. Building viable infra-structure and indigenous capability in science and technology is a long-term process. But in most of the LDCs there is immediate need for technological improvements to subserve developmental efforts in various sectors of their economy. Some of these needs can probably bemet by transfer of appropriate technology available in the industrialized countries, but in many cases, particularly in developing latest resources and making more productive use of known resources, the countries encounter problems which need R&D for their solution. It is very vital for these countries that such problems are identified as quickly as possible and the R&D projects related to them are undertaken in time. Most of the LDCs will need considerable efforts and time before they can tackle all these problem in their own institutes whereas it may be quite feasible for the industrialized countries to undertake many of these projects in their laboratories with the existing facilities and personnel. It should, however be clearly understood that specific projects to be so undertaken must relate to national priorities in the development plans of the LDCs and the results obtained must be freely transfered and utilized for their benetit. This sort of scientitic co-operation must also ensure effeictive participation in the projects by personnel from the LDCs. This will serve two purposes namely, (1) training of the LDC personnel and (2) injection of local expertize knowledge and experience in the projects so as to orient them towards meeting local conditions

and needs. Such programmes may be initiated by the national policy-making and planning bodies of the LDCs in consultation and general agreement with counterpart national agencies in the industrial countries. Details of programmes must, however, be finalized by direct contacts and agreement between the concerned institutes and scientists in LDCs and industrialized countries.

In conclusion I may mention that most of the LDCs are now in the process of redefining development theory and practice in the face of severe internal problems and tensions. They have to broaden development goals to embrace not only increase in GNP but alleviating mass poverty and its symptoms - hunger, malnutrition, disease, illiteracy and massive unemployment. They must seek ways to provide " a minimum bundle of goods and services to the common man." For this they need greater self-reliance in using science and technology for development and to achieve this they need effective cooperation from the international agencies and technologically advanced countries.

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XXVII-29

THE FUTURE OF STRATEGIC ARMS CONTROL: A DISQUISITION ON THE WISDOM OF ANTICIPATING AN IMPASSE IN NEGOTIATIONS AND PREPARING TO COPE WITH IT

Thirty years into the nuclear era one cannot analyze the prospects of strategic arms control without resting upon judgments about what has gone before. I would like to offer--necessarily in summary form--a set of historical propositions which seem to lend important perspective on the process of strategic arms control and which serve to lift the focus of discussion somewhat beyond the most immediate events. The resulting analysis suggests that partial limitations on strategic force size and on qualitative composition may well have achieved already most of what is likely to be achieved by such measures and that progress towards a more stable world peace may depend upon opening up a new dimension of discussion; namely, the regulation of strategic force operations. This would be a very significant shift in substantive focus but it would not require radical changes in international politics of the sort that have historically been so difficult to achieve.

1. Historical Judgments and Predictable Difficulties

The first set of assertions holds that the extensive and elaborate preparations for war in which major industralized societies have engaged for the past thirty years are due more to fundamental disparities in the political values, economic organization and cultural base of these societies than to moral or intellectual failings of their statemen. Dramatic departures from the defense policies which have evolved are not likely within the existing structures of national government nor are drastic changes in these governmental structures likely to occur which would enable rapid and

comprehensive programs of disarmament to be carried out. Though the goals and detailed requirements of general disarmament and of lasting international peace should always be pursued, that process should not inhibit more limited arms control measures or disparage their significance. What has been accomplished in the area of strategic arms control, however inadequate against absolute standards is nonetheless quite valuable under the existing conditions of human affairs. Limited arms control through bilateral negotiations remains a major hope for future progress.

Second, the constraints on strategic armaments achieved to date have been imposed in the first instance by national governments operating within the framework of their own defense policies. To a close approximation, international agreements have ratified and fortified these constraints but have not extended beyond them. This is a significant accomplishment since strategic deployments yet higher than those which actually exist have been ecnonmically and militarily feasible, but the limited nature of the accomplishment should be clearly perceived. With few exceptions, national defense policy commitments once made have not been reversed by international arms control arrangements.

Third, in the extended process of articulating and negotiating formal agreements limiting strategic arms, a conceptual structure has been developed which--at least in the United States--provides widely accepted principles for stabilizing the international balance of strategic weapons and which seryes to define the next steps for arms control. Under this familiar program, peace is to be protected by the deterence effects of off-setting threats of destruction in retaliation for prior attack, and the specific provisions of arms control agreements are designed to protect the capacity to engage in retaliatory destruction. For this purpose meaningful missile defense deploy-

ments have been precluded in the United States and the Soviet Union and at least temporary limits have been set on their respective offensive forces. Within the logic of this program, the course of natural development for arms control is to seek reductions in the force levels allowed and restriction on those qualitative improvements which would confer greater ability to destroy opposing forces in a first strike. The United States government is now seized with the attempt to achieve progress along these lines, and this commitment is not as much a result of the political character of its new administration as it is the natural evolution of a well-established national security policy.

If these judgments are used to structure an analysis of the current strategic situation, an obvious problem emerges. The course to which at least one of the major national governments is committed requires a very basic extension in the character of strategic arms limitation arrangements; that is, any combination of substantial reductions in forces and restrictions on qualitative development will undoubtedly require a reversal of existing national defense policy commitments. For all the governmental systems involved, that will be far more difficult to achieve politically and organizationally than any of the provisions accomplished to date--increasingly so as the reductions and qualitative constraints under consideration affect existing military capability. Because of the leeway allowed by very high force levels and by the presence of earlier generation weapons (which could either be retired or retained longer as circumstances dictate), there is reasonable hope that this intrinsic difficulty will not be a major problem in the short run. Eventually, however, the problem seems to be enough of a threat to the development of limited arms control arrangements and to the international political atmosphere that

serious analysis of the possibility ought to be undertaken. It is highly pertinent therefore to pose the question: What should be done if progress on the established agenda of strategic arms control becomes impossible?

2. More Historical Judgments and a Promising Response to an Impasse in Arms Control Negotiations.

A serious answer to that question can be developed from a careful reading of the more recent history of strategic arms developments. It is rather clear that basic force structures of the two central strategic protagonists--the United States and the Soviet Union--were decided upon at the highest political levels during the period 1958 to 1965 when ballistic missiles were being added to force inventories for the first time. In that era the major policy questions concerned first the overall size of strategic force deployments that were to be undertaken and second very basic questions of technical composition such as distribution between land and sea based systems, fixed-site or mobile deployment on land, hard or soft configurations for the fixed-sites, accuracy/yield values for the warheads and strategies for penetrating missile defense systems with offensive warheads. These matters appear to have been decided in broad outline during that era; and, as a result of the large deployments which followed, substantial inertia was built into each of the opposing force strucures. In the turbulent political events of the period momentary force balances (which were rapidly changing) became politically important--notably, in the Berlin crisis in 1961 and in the Cuban crisis in 1962--and apparently taught lasting lessions to political leaders. Reflecting these lessons, the arms control discussions (and the eventual agreements) of ensuing years focused on the questions of force size and basic technical composition.

The large force structures which were programmed during the early to mid-1960s did not physically emerge until somewhat later and the very complicated technology involved was not fully integrated into the respective military establishments until even later than that. These processes have now substantially occurred, however, and as a result the strategic situation has been transformed. The long imagined capacity to undertake destructive military operations on very short notice was finally created in the forces of the United States and the Soviet Union and is now being maintained on a day-to-day basis. This organizational maturation of opposing strategic forces has rendered the established policy questions--the programming of future additions to strategic forces--relatively less significant and has made the daily disposition and management of existing forces relatively more significant.

Unless the progress of force reductions is truly dramatic, the safety of the world for medium-term future will probably depend far more on how existing force levels are managed--both on a daily basis and under crisis conditions--than upon force programming decisions. Arms control discussions to date have only entered the fringes of what might be involved in regulating operational force activities. It seems inevitable that such questions must eventually be addressed thoroughly and systematically, and there is an obvious argument that this should occur all the sooner as progress on questions of force size and qualitative improvements becomes difficult.

Concrete proposals designed to stabilize strategic force operations have not been as elaborately developed or as widely discussed as other arms control measures, and this alone dictates caution in advancing specific recommendations. There are some basic principles, however, which are obviously important for this type of arms control and some proposals which at least

serve as illustrations. Clearly it is desirable in the interests of arms control to reduce the readiness levels of strategic forces, to remove the occasions where strategic force elements of opposing powers might engage in hostile but not directly violent tactical interactions (either by accident or at the initiative of low level commanders), and to restrict the habit of sending diplomatic signals by means of strategic force operations. Though specific implementation of these principles is likely to be controversial, it is at least conceivable that formal or informal arrangements along these lines might be worked out. Until a serious attempt is made, the degree of political difficulty cannot be known.

An obvious specific proposal which would fit the spirit of operational force stabilization would be the restriction of ballistic missile submarines to ocean areas well removed from an opponent's shores from which hostile ASW operations would be prohibited. Given the range of current generation SLBM's, this is technically feasible without a major degradation of strategic capability. If properly designed, this arrangement would enhance protection of SLBM forces from sudden attack and would remove a major condition for low-level tactical engagement. Such a provision would also reduce the possibility of an attack being initiated completely without warning and thus would relieve at least one source of pressure to maintain forces on high alert status. Whether or not an arrangement of this sort could be designed and negotiated must remain an open question at this point, but there is ample reason to begin thinking along such lines.

In summary, while one must hope that current attempts to achieve reductions in strategic force levels and restrictions on qualitative improvements will be successful, failure does not counsel either despair, hostile national reaction, or radical departure from the current process of limited arms control. A great deal of stabilization in basic force structures has

in fact occurred, and it is not at all inevitable that in the absence of immediate reductions national governments will repeat the very rapid and extensive procurement of strategic forces characteristic of the 1960s. Moreover the limits of human ingenuity have hardly been reached in designing new forms of stabilizing agreement. There are severe pressures associated with political conflicts, with the continuing advances of technology, and with the established momentum of arms competition but that is all the more reason to maintain perspective. Cool reason has not yet been driven from the field.

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R.W. Ditchburn (UK) XXVII-28

FACTORS WHICH DETERMINE THE LEVEL OF ARMAMENTS

Introduction

It is the purpose of this note to suggest that our study of the factors which determine the level of armaments in the past and which operate to-day, has not been adequate. If we could understand these factors better, we might be more effective in our endeavours to change the situation. It is obviously not possible in a short paper to make a major contribution to a very complex problem. Instead, I hope to identify some of the factors involved and to suggest lines of approach which might be followed if SIPRI or Pugwash were to establish study groups in this area. The co-operation of scientists, economists and historians of social history is needed to obtain useful results.

It is easy to understand why the level of armaments in the world to-day is not ten times higher than it is. The manpower and economic potential for such a large increase do not exist. It is also not too difficult to see that a reduction of armaments by a factor of a thousand would introduce new variables to the political situation. Probably the possibility of victory by surprise attack, - by first strike - would increase. If the first strike did not bring victory then speed of manufacture of armaments might be decisive. Although we can thus see - at least in general terms - why the level of armaments is not very much higher, (10 times) or very much lower (1000 times), we encounter serious difficulties when we seek to narrow these limits, - as we should do in building a scientific theory of the situation. We do not understand why the level is not three times higher than it is, - indeed it may be three times higher by the end of this century. Similarly, it seems to be commonsense that a reduction by a factor of ten, leaving relative powers unchanged, would benefit all nations. Nevertheless, all the endeavours of men of goodwill and high intelligence and all the disarmament conferences have succeeded only in slightly reducing the rate of increase of armaments. No reduction in actual level has occurred. We do not basically understand why this is so.

What kind of understanding is needed

Let us consider the analogy of fire. To primitive man fire was a useful tool in providing warmth, in cooking food and in frighten-

ing away wild beasts. It was also a danger if through accident or human action a large area of forest was set alight. Man gained some understanding of how to use fire and how to prevent it from getting out of control long before Lavoisier studied the chemistry of oxidation. Nevertheless, the deeper understanding led to a more efficient use of energy and also produced more effective fire extinguishers.

In relation to armaments, we still lack the kind of empirical knowledge which early civilizations had about fire. We do not understand on the level of economics or politics the forces whose equilibrium determines the present level of armaments. We should now seek for the most complete understanding at this level because this knowledge may help us to divert resources now used in the arms race to useful purposes.

A psychologist may say that this approach is superficial. The real causes of the arms race are to be found in irrational fear from the deep unconscious. This may be true but it is not at the present stage very useful. It is like the chemistry of oxidation - it may be valuable one day but at present a more empirical approach leading directly to action is needed.

Quasi-equilibrium

The present situation is one of approximate equilibrium between opposing factors. The equilibrium point is gradually shifting in the direction of increase of armaments. It is not a runaway situation though it may become so in the not too distant future. In an equilibrium situation an increase of armaments produces an increase in opposition to armaments (e.g. a resistance to increase of taxation). This is a stabilizing factor. In a runaway situation each increase of armaments by one country produces a larger increase by another and the situation becomes unstable with the possibility of an exponential increase. At present we can see that destabilizing factors are operating but the runaway is being prevented (a) by stabilizing factors, and (b) by a kind of political inertia operating like a viscous resistance in a physical problem. Thus we need to understand not only what factors operate but how the equilibrium is established, why it is shifting and why the changes are not exponential.

Factors involved

To-day the following factors operate to increase armaments:

(a) Fear of the armaments of others based on incomplete information. It is the estimated level rather than the real level which counts. Advocates of increase of armaments urge that we must prepare for the "worst case" and this worst case is worse than reality. Thus, if each of two nations is nominally seeking parity, each is really seeking a large superiority. This is a destabilizing factor tending to produce runaway.

(b) Scientific and technological drive, - ideas are produced for new weapons, this creates "demand" for the new weapons, but demand for the old ones does not fall so rapidly, - hence the overall effect is an increase.

(c) Profits for the arms industry in the west: the corresponding force in the east is the increase of importance of individuals who control large portions of industry devoted to arms.

(d) National pride: the desire to be able to say "we are the greatest". This is perhaps less important to-day than in the past but is still a significant force.

(e) Desire for political influence, - no intention to go to war but a desire to use weapons as a threat either aggressively or defensively. These two are not always distinguishable. The deterrent may mean merely that one does not want to be attacked or it may cloak an aggressive foreign policy.

We can also recognise the following factors which limit armaments:

(i) Economic, - there is an increasing resistance to taxation as the level increases. This may take the form of political opposition - the people elect a Parliament which will not vote the taxes, or there is increasing ingenuity of tax evasion. In a dictatorship increase of taxation beyond a certain point leads to downfall of the ruler, e.g. Charles Ist of England whose levy of ship-money led in the end to his execution; or the taxation of American colonists needed to pay for the war which had removed the menace of attack from the north, this led to rebellion and independence.

(ii)Economic, - dividing the cake. When the level of taxation is decided, the military budget has to compete with the ever-increasing pressures for more expenditure on education, health etc.

(iii) Competition between weapons. When technologists are (a) pressing the advantages of new weapons versus old weapons, (b) opposing other new weapons in order to secure the development of one particular weapon, then they have less time and energy for generation of still newer ideas. The whole process is slowed by internal conflict.

(iv) Moral forces: including both (a) pacifism and (b) a revolt against the wastefulness of the arms race.

There are also a number of external forces which produce an effect on the level of armaments which are not logically related to it. Examples are:-

(a) In Britain the Conservative Party, which favours more armaments than the Labour Party, may come to power for reasons which have nothing to do with armaments. These changes of government and hence of arms policy may act either way.

(b) In a dictatorship, and to a less extent in a democracy, the state of health of a leader or the happiness or otherwise of his family life, may affect his actions in relation to arms.

The very rapid increase of arms is also opposed by the following considerations which are analogous to a viscous force:-

(i) A general opposition to change, either in quantity or quality, extends also to weapons. All is well now - why change?

(ii) The inertia of the governmental machine - committee structures etc.

(iii) The time scale of technological development. From the first idea to the quantity production of a device takes 2 to 10 years however strong the pressures in favour. It is difficult to maintain momentum.

(iv) A reaction against alarmist ideas; the media and the military lobby cry "wolf" too often and response to warnings that "the enemy is arming faster than we are" fails not through pacifism or opposition but simply through inertia.

These forces are morally neutral, having no special reference to armaments. Nevertheless, they are important; they may be the main preventive of a runaway arms development. To some extent they, or similar forces, oppose rapid disarmament.

From this point the study may follow three paths. First, there is the method of the biologist seeking to control a pest, - the mainly qualitative study of the life cycle of the past and a study of

its predators. Then the attempt to interfere at a favourable point in the life cycle, - or to assist the predators. Secondly, there is the approach of the physical scientist, - to seek to write an equation between the various forces, then to quantify as many as possible and to seek to find a sensitive parameter where a small change may have a big final effect. Thirdly, there is the approach of economics or socio-political science. This is to ask who is motivated towards an increase of arms, who gains and who loses, and to seek to alter the motivation.

All of these approaches are important and different kinds of expertise involving a co-operative effort are needed. Greater understanding in this area may help and can do no harm. It is worth some effort.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

J. Lundin (Sweden)

XXVII-30

VERIFICATION OF A BAN ON CHEMICAL WEAPONS - A SUGGESTION FOR MUTUAL ON-SITE OBSERVATIONS

Purpose of verification in the technical sense

The purpose and the performance of verification of different kinds of arms control agreements has indeed been thoroughly discussed. This is also the case with respect specifically to a convention prohibiting development, production and stockpiling of chemical weapons and prescribing their destruction. However, the verification problems seem to be much more complicated for a ban on chemical weapons than for most arms control agreements discussed so far.* In the present paper reference is made only to a process with the purpose of actually finding out what is going on. The technical means for doing this are not scrutinized. A discussion on what will be possible to find by different methods is left out here, since this is of no principal interest for the problems discussed.

Possible verification mechanisms

General

There are, in a general sense, two types of verification methods, intrusive and non-intrusive. The former usually require access to a physical territory of the party to be verified in order to make observations, take samples or make measurements with different kinds of equipment. For these activities to be performed it is not always necessary to have human observers present at the time of the activity to be verified. Samples can be withdrawn automatically, and black boxes can perform measurements which do not need immediate supervision. According to their design they can only make such measurements and take such samples for which they are preprogrammed. This, on the other hand, makes it possible to take countermeasures against their registrations.

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* Here is referred to treaties in which verification measures actually have been initiated or have been required. It should be noted that the biological weapons (BW) convention was agreed upon without provisions for verification, which probably would have been still more difficult to find than it now is for a CW-convention.

Non-intrusive verification measures by definition must work with phenomena and information which are available outside the territory of the party to be inspected. Some non-intrusive methods certainly leave no doubt about the phenomena they register. Satellites can count physically manifested phenomena on the earth without actually intruding into the territory of a party. Radioactive particles in the air can be sampled and analyzed, seismic waves also can be observed and analyzed. However, they may be evaded if particular precautions are beeing taken meaning that they may not always be totally reliable. Usually, the results of other non-intrusive verification activities and especially those which are of interest in connection with a CW-ban, can only give more or less strong indications of suspected violations of an agreement. Accordingly they cannot serve in giving absolute confidence whether given information or observed phenomena really imply violations or not.

The shortcomings mentioned above leave us with situations where the only possibility to gain reliable information and certainty about doubtful events may be to observe them physically by means of human observers.

On-site observation

The question of on-site observation has been a crucial one throughout the modern negotiations for arms control. Some countries regard them as inacceptable mainly on the ground that a sovereign state cannot accept examination on its territory. It is further claimed that such observations may also lead to revelation of non-relevant knowledge to the opponent, which is regarded as espionage.

Other countries claim that in certain cases it is necessary to resolve differences in opinion with regard to possible violations of the provisions in a treaty by means of on-site observations. Such on-site observations serve the double purpose of both establishing, as far as possible, the facts of the situation and providing a sufficiently strong deterring effect, which is one purpose of a verification measure.

It would be easy to accept the position of the critics of on-site observation if history had not shown that sovereign states often prepare themselves secretly in various ways to surprise an opponent if it comes to an open conflict. Also the line of the on-site observation proponents would be irresistible if there was not a substantial doubt that on-site observations could be used also to harass other countries and to gain, unduly, knowledge advantageous for oneself.

The following proposal represents an attempt to find a reasonable compromise between the two views presented above with respect to the negotiations on banning chemical weapons.

The consultative committee

Let me first to recall that in the last few years a new element has appeared in the discussions regarding new arms control agreements. That is the consultative committee. This originally emerged during the SALT talks and appeared in the ABM-treaty of 1972. It implies the establishment of a politically low-level committee between the parties of the treaty with the function to serve as a forum for discussions on disputed points with regard to the treaty. Accordingly technical question marks can be discussed, doubtful findings and observations can be raised and explained. One of the main features of the consultative committee procedure is that the deliberations on these matters are kept secret between the parties. These arrangements seem to have substantially increased the possibility to disperse doubts between the parties and also to pave the way for understandings between them with respect to different phenomena. It also seems to be highly appreciated by the parties to the SALT agreement. Attempts have recently been made in several negotiations on arms control treaties, i.e. first in the environmental modification treaty (Enmod), more recently in the CW and complete test ban (CTB) draft treaties (UK, CCD/512) and (Sweden, CCD/518, respectively) to arrange for consultative committees.

Function of a consultative committee with respect to on-site observations

In the British CW draft treaty the intention is that the consultative committee should arrange for on-site observations. So far, no detailed discussions on how this would be possible or how it would be performed have taken place.*) It seems obvious, however, that the drafters envision closed discussions with respect to on-site observations. In this connection different formal approaches have been suggested:

that parties should be able to ask for on-site inspections, so called "inspection by challenge";

that parties could invite other parties for on-site inspection, when they wanted to clarify doubts, so called "verification by invitation".

So far these propositions have implied one-sided activities. However, to the author it seems possible to combine these two prospects into one, which might be called "mutual on-site observation". The proposition is being outlined in the following.

Mutual on-site observation

Formal arrangements

Given the arrangement of a consultative committee within a CW convention a forum for discussions on questions related to the convention is provided. Among other things, within the framework of the consultative committee (and of course also outside of it, which, however, does not seem to be a pertinent alternative) parties which feel threatened by or have reason to believe that the convention is violated by another party, could ask that party for an on-site observation and accompany it by an invitation for the country to be observed to perform some corresponding observation in the complaining country. Several advantages would seem to follow by such an arrangement.

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*) An earlier Japanese draft CW treaty foresaw to a large extent the same functions but recommended another organisational framework, an International Verification Agency or IVA.

Advantages

The first and most important advantage would be that the mutual arrangement did not insult the sovereignity of any state or any of the parties involved. Preparatory discussions on the matter in doubt could be arranged through the consultative committee without risk for prestige loaded open discussions. When, and if, the observations were performed the results could be held for themselves by the parties with respect to technical details, only stating, perhaps, whether they were satisfied with the result of the investigations or not, in accordance with the requirements of their own security.

It seems to the author that the proposed procedure with mutual on-site observation would constitute a natural barrier against unfounded or political accusations for violations. Requesting an invitation for inspection of another party and offering some corresponding activity to be inspected in your own country would imply several restrictive elements. It would involve several stages in which the matter could be clarified, i.e. by a preceding discussion in the consultative committee before the actual observations, which thus should have to be very carefully negotiated between the parties taking into account that the parties should be able to visit each other. Since no results had to be published the parties could always consider themselves satisfied with the results, whether any violations were actually found or it was shown that the accusations were unfounded. A party which actually did not want even to negotiate a mutual on-site inspection automatically would come into a very bad position with respect to the restrictive factors mentioned above. He would turn up as non-cooperative and would probably be perceived as trying to perform prohibited activities covertly. Unfounded accusations would be restricted particularly if they were being made for political reasons to parties who were innocent and could prove that. The innocent parties would gain the bonus of having been able to inspect the accusing party.

The system with mutual on-site observation, might give an important contribution to the feeling of equality between states. If accepted it might to some extent neutralize the advantages that the super-powers have in their reconnaissance satellites and very large and effective intelligence services. It might be particularly well suited for a CW-ban, which would be most complicated to monitor in all those aspects where doubts would arise and for which a confidence building mechanism for resolving doubts then would be particularly strongly felt.

Disadvantages

A procedure with mutual on-site observations certainly have some obvious disadvantages and possibly some more may be found during a more detailed discussion of the proposition.

One might imagine that a small country might ask, without obvious reason with regard to his military security, a very large power for on-site observations knowing well that he had nothing to offer in return but just to expose the larger country. However, again with respect to the different restrictions mentioned above and also to general political conditions, one might think such an action to be unlikely.

Another difficulty would be the dilemma in which a party would be if he feels threatened by a perceived violation by another party against a CW-ban. He might ask the party, which behaved threatening, to be invited to inspect his alleged preparations for chemical war. Then if the complaining party had made some preparations to protect himself, he might reveal to the adversary exactly how effective his own protection was, thus giving the adversary valuable information. In the case his protection was bad, this fact might restrain him from asking the threatening party for on-site observation, at least if a crisis was imminent.

On the other hand in a long range political situation, he might not care about his own protection being exposed, but instead want to make the world observe a possible violation, which might serve his own security interests. If the complaining party had a good protection he might also make it a case to be able to present this strength in order to avert future attacks with chemical weapons.

One problem, which certainly will have to be discussed thoroughly, although it is not the purpose of this paper as mentioned, is the real value of performing on-site observations. It is probably that such a difficulty cannot be given a definite and sole, principal solution. However, one of the values, mentioned above, with mutual on-site inspections lies in the discussions which should preceed any actual observations.

Conclusions

It seems worthwhile to analyze more in detail the proposition that a CW-convention which provides for a consultative committee, should also formally institute the concept of mutual on-site observation as an ultimate means of resolving verification problems. Such inspections should be discussed and negotiated in closed sessions within the framework of the consultative committee and performed and summarized only by the parties involved.

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P.L.Ølgaard (Denmark) XXVII-31

THE NUCLEAR PROLIFERATION PROBLEM

(as seen from the point of view of a non-nuclear weapon state)

1. Introduction

It is hardly surprising to find when evaluating the role of the various nations in World polities that the influence of the major powers, e.g. the nuclear weapon powers, is considerably larger than of the smaller countries. Nor is it unreasonable considering the larger populations, the larger resources and/or the larger level of development of these powers.

There are however areas where the influence of the major powers is larger than reasonable, and it may sometimes be so dominating that it can be counterproductive. One such area is nuclear weapons proliferation.

If the aim of measures against nuclear proliferation is to prevent futher spread of nuclear weapons then it is the smaller countries which are the prime importance, since it is these countries which might proliferate some time in the future. Thus these countries should play a major role in non-proliferation negotiations to ensure that the measures agreed on are viable since it is the smaller countries that will be most affected by the measure.

The nuclear weapon powers are of less importance in this connection since they are the countries that have already proliferated. Yet it is these powers which have been and is dominating in non-proliferation negotiations. This domination has already had a number of consequences which may in the long run contribute to further proliferation.

2. Is proliferation undesirable?

Although there are those who believe that nuclear weapons proliferation is desirable since it will contribute to the destruction of the nuclear hegemony of the two superpowers, there seems to be widespread agreement that proliferation is highly undesirable for a number of reasons.

It should be fairly obvious that the larger the number of countries that possess nuclear weapons, the higher the risk that these weapons will be used in armed conflicts. Such use is extremely undesirable, not only because of the enormous destructive power of nuclear weapons, but also because "regular" use of these weapons would lower the mental threshold for the use of nuclear weapons in other countries.

An increase of the number of nuclear weapon powers would also make negotiations on nuclear armaments more difficult, since more countries would have to agree at the same time.

It has sometimes been argued that further nuclear proliferation makes a major nuclear war more probably since the superpowers will unavoidably be drawn into any local, nuclear conflict. This, however, does not seem very probable. Even if a country which has proliferated and which is allied to a superpower gets involved in a local, nuclear war, the super power is likely to stay out since its entry in a nuclear conflict may easily result in a major nuclear war with enormous and unacceptable destruction on the territory of the superpower. Consequently while futher proliferation is not likely to increase the chance of major nuclear wars significantly it may easily reduce the credibility of existing military alliances, if members of the alliances proliferate. And a decrease in the credibility of the alliance may easily lead to futher proliferation and destabilization.

3. Is proliferation immoral?

It is sometimes claimed that proliferation is immoral or even criminal. If this is so - and many good arguments can be advanced in support of this claim - then obviously it is the countries, which have already proliferated, i.e. the present nuclear explosive countries that are immoral or criminal.

It is not the non-nuclear weapons countries which are immoral or criminal because they may perhaps some time in the futher join the immoral league of the nuclear explosive powers. And it is certainly not the non-nuclear weapon countries which by ratifying the NPT have promised not to acquire nuclear explosives that are immoral.

Some have tried to argue that if only a country has proliferated before a certain date it does not belong to the immoral league. This is of course nonsense. One might even argue that the earlier a country has proliferated, the more nuclear weapons it does possess, the larger damage it can cause and the more immoral it is.

4. Why do countries proliferate?

The best way to get an idea about why countries may proliferate in the future is to analyse why countries did so in the past.

The first country to proliferate was the US, which detonated its first nuclear device in 1945. The main motives behind the US development of the atomic bomb were strategic and military; they were to produce the bomb, if it could be done at all, before Germany did so in order to prevent or deter a possible German use, but also to use it as a weapon in support of the US forces in World War II.

The USSR proliferated in 1949, presumably mainly to counter the US development of nuclear weapons, i.e. for security reasons, but probably also to achieve the prestige connected with the possession of nuclear weapons.

The UK proliferated in 1952 and France in 1960, both countries mainly for prestige reasons.

In 1964 China proliferated, presumably to deter any nuclear attack on its territory, i.e. for security reasons. The last member of the nuclear explosive club, India, proliferated in 1974. The official reason for the Indian nuclear explosion was the need for developing the peaceful use of nuclear explosions, but prestige has undoubtedly played an important role.

Thus the two main motives for proliferation has so far been prestige and security (including deterrence). It seems likely that any proliferation that may occur in the future, will originate from the same motives.

It is no coincidence that the present nuclear weapon powers all belong to the leading powers of the World. However the leading powers are not likely to remain the same forever. Some will drop out of the leading group, other will enter it. A country like Brazil which is expected to have approximately 200 million inhabitants around year 2000 and which has large, unused natural ressources may well in ten to twenty years become a new member of the leading group. If the leading powers still at this time maintain their present arsenals of nuclear weapons or even have expanded them, it seems most unlikely that new members of the leading group will not feel obliged to acquire nuclear explosives.

If this happens it may start futher proliferation and the World may see a number of new nuclear weapon states, e.g. Brazil, Argentina, Pakistan and Indonesia, none of which have ratified the NPT. It is not likely that any of these countries will detonate their first nuclear explosive in near future, but on the other hand the development of a nuclear explosive capability may already be underway. So unless something is done quite soon to stop this development it may have gained so much momentum that it will be too late to do anything about it.

What can be done to stop this development?. "Arm twisting" may

work in the short run, but in the long run it will only delay, not stop it. In the long run proliferation to new, major powers can only be prevented if the role of nuclear weapons in international polities is drastically diminished. And this can only be done if the present nuclear weapons agree on a drastic reduction in their nuclear weapons stockpiles, e.g. down to a few per cent of the present levels. Preferably nuclear weapons should be completely abolished, but this may not be achievable in the next 10 to 20 years, considering how slow the progress has been in the nuclear disarmament field in the last 10 to 20 years.

If we look at the countries which for security reasons may go nuclear, it is interesting to note that with the possible exception of Pakistan these countries all belong to the smaller nations. It is countries with special, but vital security problems such as Israel, South Korea, South Africa and Taiwan. The security of most of these countries is today based on the support from one or a few major powers. But their security situation is very precarious because they may suddenly loose this support without having other powers to turn to, and because they have very powerful enemies.

For these reasons it could be of interest for the countries to acquire nuclear weapons to deter their enemies from attacking in the situation where the major power which has hitherto given support, deserts them. On the other hand they can not risk actually to acquire nuclear weapons as long as they have the support of the major power, since such an act will most likely accelerate the desertion process. Therefore the countries may try to maintain a credible nuclear option with a short lead time for weapon production, but without producing any nuclear weapons.

Thus there will be no actual proliferation as long as the necessary support is obtained, but there will of course always exist the potential risk of proliferation.The safest way to avoid that this risk turns into reality is to give these countries the desired support. Another supplementary possibility is that the major power demands certain limitations on the nuclear energy activities of the country in return of the support.These limitations could include no enrichment or reprocessing facilities and no storage of fissile materials.

The best way to ensure against proliferation due to security needs may well be credible alliance systems. There can be little doubt that a major reason why there has been no nuclear proliferation in Europe since 1960 is the existence of NATO and the Warsaw pact. This also means however that should these alliances deteriorate than the risk of proliferation in Europe will greatly increase.

5. The non-Proliferation Treaty (NPT)

The major legal instrument to prevent proliferation is the NPT which entered into force in March 1970.

The NPT was drafted by the two superpowers and only during the final negotiations did the non-nuclear weapon countries have the opportunity to introduce minor changes to the treaty. Yet, more than 100 non-nuclear weapon states or more than 2/3 of these countries have become parties to the treaty. They have done so in spite of the fact that in several respects the NPT is rather unbalanced. To some extent it has to be unbalanced, since its very purpose is to prevent futher proliferation. Therefore it is necessary to accept that some countries have nuclear weapons - at least for some time to come -, while others have to forego this possibility. However while the non-weapon states have to submit all their nuclear facilities to inspection, this is not so with the weapon states. Futher while the non-weapon states have to forego a nuclear weapon capability from now on, the weapons states only undertake to pursue negotiations relating to nuclear disarmament. These imbalances have undoubtedly contributed to the sad fact that a number of countries has not become parties to the treaty although these countries may have additional reasons for not joining the treaty as discussed earlier.

Since the entering into force of the NPT in 1970 the number of parties to the treaty has steadily increased, and no country has left the treaty. Further, all non-weapon states had accepted IAEA safeguards, and none of these countries has been accused of not living up to its obligations under the treaty. Also there has been no indication that any of the non-weapon parties to the treaty are on the verge of producing nuclear explosives. Thus the non-weapon parties have in all respects lived up to the treaty.

The situation is not quite so satisfactory when it comes to the obligations

of the nuclear weapon states, which are parties to the treaty. Although they have pursued negotiations to stop the nuclear arms race, little has come out of them. The ABM-agreement of SALT-I is probably more due to the impossibility of - at least at the present stage - to build an efficient ABM-system than to a sincere desire for disarmament. And the reason for the Threshold Test Ban and Protocol seems primarily to be that large nuclear weapons are no longer needed due to the increased precision of modern strategic weapons.

During the NPT review conference in Geneva in 1975 it was very clearly demonstrated that there exists a very strong demand among the non-weapons parties to NPT, in particular among those of the third world, for some significant steps towards a cessation of the nuclear arms race and nuclear disarmament. If such steps are not taken before the next review conference in 1980 it seems quite likely that the NPT will deteriorate. At the same time the prospects that the SALT negotiations will in time result in significant reduction in the number of nuclear weapons are not particular bright. Agreement e.g. on ceilings above or at the present level of the nuclear weapons stockpiles will not suffice.

Thus to prevent nuclear weapons proliferation it is not enough that the non-weapons states refrain from doing something. It is also essential that the weapons states do something, and they have to do it soon.

6. The non-proliferation policy of President Carter.

While the prospects of preventing proliferation do not seem very bright as mentioned above, they have hardly improved by the April statement of President Carter on the future US policy on nuclear power. In this statement President Carter deferred indefinitely commercial reprocessing, recycling of plutonium, and the plutonium breeder in the US programme, and indicated that the US would urge other countries in join this policy. The reasons for introducing these restriction in the use of nuclear power were, according to President Carter, the Indian nuclear explosion in 1974 and the feeling that several other countries are on the verge of becoming nuclear explosive powers.

It is true that the mass media at regular intervals claim that some countries, e.g. Brazil, Argentina, Pakistan, Israel, Egypt, and South Africa, intend

to produce nuclear explosives or weapons some time in the future (or have already produced them). None of these countries are however parties to the NPT.

The possibility that some countries outside the NPT might produce nuclear explosives, can not be used as a reason for restricting the use of nuclear power in the non-weapon countries of the NPT. This would be tantamount to collective punishment, a punitive method not usually accepted among civilized countries.

In ratifying the NPT the non-weapons parties to the treaty have made clear that they will not produce nuclear explosives. To impose on them stricter limitation regarding their use of nuclear power than involved in the NPT without any indication that they intend to violate the treaty, is tantamount to saying: "You have said that you are not going to make nuclear weapons, but we don't trust you". That is hardly an up-to date way of conducting foreign policy. It simply means that all treaties are only considered "a scrap of paper".

Further it is difficult to see how the introduction of severe limitations on the use of nuclear power can be anything but an infringement of article IV of the NPT. The suggested limitations certainly affect the inalienable right of the parties to the treaty to develop the use of nuclear energy for peaceful purposes.

Finally it seems strange that while commercial reprocessing of fuel from power reactors should be stopped, the production of highly enriched uranium for military purposes and of plutonium and tritium from production reactors should go on in the nuclear weapon states. It goes without saying that many non-weapon countries are unlikely to accept the logic behind such an arrangement. It could better be descriped as hypocrisy.

The measure proposed by President Carter to impede nuclear proliferation may well have the opposite effect of the intended.

7. What should be done?

Even though the number of nuclear explosives powers has reached the alarming value of 6 something can still be done to prevent futher proliferation provided a number of conditions are fulfilled.

I. The nuclear weapon powers to the NPT must stop treating all the non-nuclear weapon countries and in particular those which are parties to the NPT as

if they were on the verge of proliferating. The basic rule must be that a country is innocent until proven guilty, not guilty until proven innocent. The nuclear powers have to understand that the non-weapon parties to the NPT are as much against proliferation as they are.

II. There are two approaches to prevent proliferation, the positive and the negative. The negative consists of prohibitions, restrictions, threats, arm twisting etc. It may be quite effective in the short run, but not in the long run among sovereign states. In his Atoms for Peace Programme President Eisenhower recognized quite rightly that only the positive approach can lead to lasting solutions. This approach involves assistance, cooperation, trade and of course also proper precautions against misuse.

III. The nuclear weapon parties to the NPT must deliver their part of the goods, i.e. they must soon take concrete steps towards nuclear disarmament.

IV. The nuclear weapon parties to the NPT must also strive to make such security arrangements that countries will not out of desperation go nuclear.

V. Nuclear power is here to stay, and the World needs it, whether one likes it or not. Attempts to block the development of nuclear power under the pretext of wanting to impede proliferation will be counterproductive. It would hardly be advisable to push countries into a position, where they will say: If we can't get nuclear power, at least we can get the bomb.

VI. It should be made more attractive to be member of the NPT, e.g. through cooperative efforts such as multinational enrichment, reprocessing and plutonium refabrication facilities and centralized storage of radioactive waste as well as fissile materials. Such measures are attractive from an economic and political point of view, and at the same time they will permit much better safeguards.

It seems strange that those who have already proliferated consider those who have not the real villains of the proliferation drama. In this connection it seems appropriate to quote the scripture:

And why beholdest thou the mote that is in thy brother's eye, but considerest not the beam that is in thine own eye?

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D. R. Inglis (U.S. A.)

XXVII-32

WIND POWER TO REDUCE NUCLEAR PROLIFERATION

Pugwash conferences have long espoused aims to limit the arms race and nuclear proliferation that have unfortunately turned out to be more ambitious than have been attainable in the real world. We are now faced with situations that we had hoped could be avoided but must still try to ameliorate them. In particular, the attractiveness of nuclear reactors as a power source that can contribute to the world's well-being has largely overcome concerns about their deleterious side effects and there is the prospect of their spreading to more and more countries, implying widespread production of plutonium that is related to future nuclear arms availability, while efforts to establish safeguards seem unable to cope with the growing magnitude of the problem.

While qualitatively the cat is already out of the bag, this trend could still be mitigated quantitatively by more widespread use of benign power sources that can be deployed on the basis of current technology. Of the prospective alternative power sources, wind generation of electric power is the most immediately promising. There have been centuries of experience throughout the world with windmills in the range of about one to a hundred horsepower used for pumping water and other mechanical tasks but more significantly there have been eighty years of experience with relatively few wind dynamos of increasing sophistication and efficiency in ranges from about one to a thousand kilowatts generating electric power that has in

some cases been synchronized with existing power grids.

The common experience with large wind dynamos has been that they failed by about a factor two, sometimes less, to be economically competitive with fossil-fuel-fired plants or nuclear plants back when fuels were less than half as expensive as now (in constant monetary units). Estimates of wind-power costs made mostly by engineers associated with the construction of some of the large experimental wind dynamos, together with estimates of the cost of power from newly constructed nuclear plants based on cost trends in the U.S., suggest that huge-scale wind power with quantity production in the next few years would cost roughly half as much as nuclear power, due account taken of the fact that the wind is variable, as is the performance of nuclear plants (performance factors being taken as about 40% and 60%, respectively). Some estimates made by government agencies and their contractors are less favorable but come largely from people accustomed to nuclear and space technologies and financing practices.

Energy storage capability such as pumped hydroelectric storage is desirable in some cases at extra cost for both nuclear and wind systems at least to help meet daily peak demand but when it is supplied in a wind system it also helps smooth out short-term fluctuations in the wind. The most economic initial use of large-scale wind power would be in combining it with existing hydroelectric power limited by river flow, the hydroelectric power being used mainly when the wind is light. No other storage or pumping is then required. In some parts of the world such as the western great plains of the U.S. there are windy, sparcely settled and arid regions where tens of thousands of megawatt-scale wind dynamos could usefully and fairly unobjectionably be deployed, requiring industrial efforts distinctly smaller than but comparable to the automobile industry and providing

a wide variety of employment.

While small-scale wind power for individual homes and shops can be important in reducing dependence on large electric grids, the economic attractiveness of large-scale wind generation of electric power depends on getting large wind dynamos into mass production. Unfortunately, no industrial organization has seen fit to make the necessary investment and rapid progress will depend perhaps on the initiative of some government to subsidize a large industrial effort or to install a large wind-power supplement to its generating facilities. In the U.S. and probably in some other countries it seems politically difficult to achieve this initiative largely because the government interest in energy development is dominated by the nuclear effort. The unnecessarily slow wind power development program in the U.S., even though it has multiplied rapidly from a small beginning, remains at the one percent level as compared with government expenditures to back up the nuclear industry. One wonders if Pugwash discussions might lead to initiative by some other government, perhaps one not so highly involved in nuclear power development, to overcome the mass-production hurdle and start the trend towards large-scale wind power.

While large-scale wind power should come into extensive use in industrially advanced countries, its beauty in regard to nuclear proliferation is that the technical skills required for its achievement are more available in the less developed countries than are the sophisticated skills required to produce and control the intrinsically more dangerous nuclear power. Most of the developing nations do need additional power sources and it would be sounder in the long run for

them to construct large numbers of large wind dynamos in windy regions partly or entirely with their indigenous engineering skills and labor rather than to import nuclear technology and remain dependent on foreign fuel services. Other solar-related energy sources will also be important in this regard but later, as they require research and development before large-scale deployment. Direct solar steam power or photovoltaic sources will be more appropriate than wind power in some tropical countries where the wind is light and solar reflectors do not have to be rugged enough to survive high winds. These and ocean-thermal, geothermal and biomass power should all be made available to fit various situations and climates as soon as practical but wind power is the one that is technically ready to go on a large scale and should be most widely promoted now, not only for economic and environmental reasons but also to reduce nuclear proliferation.

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J. P. Perry Robinson (UK) XXVII-33

CHEMICAL WARFARE
NEAR-SITE VERIFICATION TECHNIQUE: ITS PLACE IN A CONFIDENCE-BUILDING STRATEGY OF VERIFICATION

The problem with on-site inspection, we are told, is that it could result in leakage of technical secrets which might stimulate CW-weapons proliferation or disadvantage chemical manufacturers in domestic or international markets. Soviet experts are not alone in expressing disapproval. From the United States, for example, we hear the voice of General Appel:*

> On-site inspections would ... give the inspectors information on matters not related to CW .... The Soviets would want to see all our industries and installations. Industrial secrets are as important as defense secrets from a number of points of view. In fundamental terms, the inspection approach is a non-starter.

And in western Europe we may observe that, even within the comparative privacy of the Western European Union, the WEU Armaments Control Agency is still unable after twenty years to apply the full on-site CW controls it has deemed necessary in connection with the obligations of the revised Brussels Treaty.

Near-site technique would be less intrusive than on-site and therefore, perhaps, less unacceptable as part of a CW-treaty verification regime. But more justification than this is needed if a major effort is to be put into developing the technique and negotiating it into a treaty. Simply because A is worse than B it does not follow that B is any good. It is necessary to look closely at the function which near-site methods might serve, at the requirements which that function makes of methodology, at the alternatives, and, with the Lundin concept of 'amplified verification' in mind, at any complementarities there may be among different techniques. In short, near-site technique must be assessed within a systemic overview of the total function of verification.

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*Major-General J G Appel, US Army (retired; formerly Director of Chemical and Nuclear Operations, Office of the Assistant Chief of Staff for Force Development), 'What about CBW ?', National Defense 61: 293-296, 1977.

The function of verification

All states participating in the current CW negotiations have declared their commitment to a goal of comprehensive CW disarmament, not a mere quantitative or qualitative CW-weapons limitation. This ambitiousness has created difficult negotiating problems, evident in the protracted debate about the competing merits of a stepwise vs a direct approach and about the different varieties of stepwise approach. But it also means that the fundamental issue for governments to decide can be stated in universal terms: Would the benefits to the national interest, including military security, of proceeding with CW disarmament outweigh the costs of abandoning the option of possessing CW weapons ? A CW convention whose provisions clearly biassed this cost-benefit assessment into one of net benefit should be acceptable to prospective signatories (unless the provisions themselves constituted an overwhelming cost in areas outside the CW equation). The key factor is clearly the type of guarantee available that the convention will be observed. For a particular state, the minimum acceptable gurantee is set by the threshold at which the degree of assurance offered out by the treaty of not being menaced by CW weapons exceeds the confidence imparted by possessing CW weapons or by remaining able to do so in the future. The overall function of verification, then, is to provide this degree of assurance.

It is possible to develop analytical frameworks incorporating military and strategic considerations which allow the threshold, and hence the verification requirements, to be defined rather precisely. For example, if attention is confined solely to the NATO/WTO confrontation in Europe, one may observe that the available supplies of CW weapons are mere pimples on the huge deployments of nuclear and conventional force, and one may go on to conclude that, since it cannot make much overall difference whether the chemicals are there or not, the verification requirements are slight.* This was the sort of reasoning which underlay the report from the first of the Pugwash CW workshops where it stated that, for the technically advanced nations,

> to assure the benefits to security of replacing a policy of chemical deterrence by participation in international chemical disarmament ... a relatively modest degree of verification may be adequate.

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*This grossly oversimplifies the analysis, of course. A more detailed expression is contained in my statement before the Zablocki Subcommittee on 2 May 1974, and in my paper 'Should NATO have chemical weapons ?' for the Conference on Policies for Chemical Weapons and Chemical Arms Control, Boston, Mass., January 1977.

But 'worst case' analyses can also be performed from which a very different conclusion can be reached. There is one which judges that the peculiar properties of CW weapons could lend themselves successfully to the spearheading of a Soviet surge designed to penetrate the 'thin crust' of NATO's forward defence without recourse to nuclear weapons. Since rather small quantities of CW weapons -- not necessarily nerve gases, even -- might suffice, and since the existence of a retaliatory CW-weapons capability might conceivably act as a deterrent, a CW disarmament treaty should, on this line of argument, be accepted only if its verification provisions are especially stringent. It appears (from, for example, the proceedings of the Boston CW conference) that this particular view is receding into a decent obscurity, at least among US Defense Department planners. Even so, the fact remains that diametrically opposed conclusions about verification can be reached from what may be termed 'objective' analyses. It thus has to be recognised that such analyses can make only a limited contribution to the resolution of verification problems.

This is hardly surprising, since the function of verification is to provide assurance, and assurance is primarily a subjective matter. Though a verification regime must obviously seek to accomodate the military and strategic realities of chemical warfare, it must also accomodate that much less tangible array of fears, myths and misperceptions concerning adversary capabilities and intentions which feeds mistrust and heightens the demand for assurance. From this it follows, again, that strategic analysis is an inadequate tool for specifying verification requirements: it has to be supplemented by considerations of the group psychology, so to speak, of the relevant decision makers. One may observe, for example, that the very process of deciding upon an arms policy, whether for chemical warfare or anything else, tends to impose a fortress mentality upon the people involved. The myths and fears then bulk large: of Soviet expansionism and resurgent German militarism; of international communist conspiracy and neo-imperialist machination; and so forth. It is then only a short step into unreasonableness: why should any conceivable safeguard be relinquished if there is a risk that by so doing the enemy's hand may be strengthened, even though it is not obvious how ? Politicians, no less than most people, are reluctant to stake their reputations against pervasive, long lasting fears. Great courage is required; or great assurance.

There is thus a duality in the function of verification reflecting the need to allay both rational and irrational (or unsubstantiable) fears about

embarking upon CW disarmament. The greater the apprehensions in a country about the real intentions of potential adversaries, the more will be the significance attached to worst-case cost-benefit analyses. The one type of fear thus exacerbates the other. In the absence of at least some degree of mutual trust, therefore, unfulfillable demands will continue to be made of verification. It follows that the primordial function of a verification regime is to create that trust.

Criteria for evaluating candidate verification techniques

This means that two different criteria need to be applied in evaluating possible verification techniques. The first is familiar enough. Would the technique increase a party's capacity for detecting a violation which, objectively considered, would seriously alter the military balance vis-à-vis the violator ? The second criterion is more for political than technical judgement, political in the sense that it relates to the prevailing currents of opinion which direct decision among politicians. Would the technique serve to build mutual confidence among parties that the agreement was being observed ? A technique that satisfied this criterion would not necessarily have to be capable of detecting violation: it need only provide indications that proscribed activities were probably not taking place. Form at least as much as substance would be important. If, for example, a particular government were to declare its willingness to exchange certain types of information, or to receive foreign visitors at certain installations or training grounds, that act could itself have a symbolical significance in the creation of trust. It would build confidence in proportion to the extent that such information-exchanges or site-visits appeared likely to increase the verifiability of an agreement, even if they were not actually exploited for that purpose.

These two criteria do of course overlap, but by no means completely. A mistake made in past evaluations of candidate verification techniques has been that the criteria have not been applied separately. Phosphorus accountancy, for example, is commonly spurned on the grounds that there would be too much noise in the system for diversion of phosphorus to be detectable within an advanced chemical industry; yet for confidence-building, and for violation-detection within less advanced chemical industries, its potentialities are great. The sort of evaluation commonly applied in the West to candidate verification techniques is imbued with a cops-and-robbers attitude to the problem which at

once both excludes confidence-building considerations and increases the need for them: attention thus becomes concentrated most counterproductively on the first of the two criteria. At the same time there is widespread belief that no single technique which is not unacceptably intrusive will provide the degree of assurance that some parties need, that more than one technique will be required, and that for that to be economical a synergy between techniques must be sought. Yet what better prospect is there for achieving this synergy than the use of complementary techniques each satisfying one or other criterion and together satisfying both ? A better approach to verification would thus seem to be one that treated confidence-building as an integral part of the overall function of verification, as a dependage more than an appendage.

A possible verification strategy

How this approach might be put into practice is suggested by the concept of verifiability alluded to above. The verifiability of an agreement is a measure of the extent to which it is technically possible for a party to ascertain that the agreement is being observed by another party. Some provisions of an agreement are likely to be more verifiable than others. Above all, verifiability will vary from country to country according to, on the one hand, the ability of each country to collect and interpret pertinent data, and, on the other hand, the transparency of the military-industrial milieu in each country within which activities proscribed by the agreement would be located if they were happening. It therefore follows that, as between two parties to a multilateral CW agreement, verifiability could be increased by unilateral action on either side. One party could increase its capacity for gathering data. The other party could relax its controls over data. Both parties could adopt both courses. The act of relaxing controls could thus become a powerful confidence-building measure. Because successive, reciprocated relaxations could, below a certain threshold, successively reduce the demands made of each party's data-collection capability, a mechanism could be set in motion for counteracting the process whereby mistrust heightens verification requirements. Herein lies synergy.

The assurance which it is the function of verification to provide stems from the verifiability of an agreement, but verifiability does not necessarily require that the agreement include special provisions for verification. The latter should have the function only of increasing verifiability, not of creating it. Thus, in deciding whether and what sort of verification provisions should be drafted into a CW convention, the fundamental consideration for each

prospective party must be the extent to which existing verifiability is inadequate. If there is inadequacy, it has to be decided whether the remedy should be specified in the form of detailed verification procedures -- as envisaged in the Japanese and British drafts -- or whether the remedy might not better be specified in some much looser, more flexible manner. Thus, the onus of verification might be placed on national means with provisions in the treaty only for some specified form of international cooperation that would serve to facilitate the enhancement of verifiability by unilateral action: an undertaking, say, for a continuing exchange of data on phosphorus consumption or on CW protection R & D programmes, or an undertaking on periodic technical exchange visits. Such undertakings would be designed to establish a permanent channel of communication between parties that could serve initially to build confidence and later, as substantive reciprocity developed, to reduce the resources that each party considered necessary to devote to national means of verification. The main problem is that of how to set the process going. It is clear that, under present circumstances, a rather powerful demonstration of good faith is needed before actual CW disarmament can begin. The British draft looks to declarations of stockpile as the requisite stimulus, but there are other possibilities also, as in the Canadian proposal* and as noted in the report from the 4th Pugwash CW Workshop.

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*CCD/PV.643, 16 July 1974.

Near-site verification technique

Near-site technique comprises surveillance of the environment immediately surrounding places in which proscribed activities might be occuring and from which emissions characteristic ofthose activities would be released if they were occuring. The surveillance would apply methods of chemical micro-analysis to samples of that environment. A number of possibilities have been considered in some detail in the open literature, including surveillance of flora and fauna in the vicinity of CW test sites and of river water downstream from waste-water outlets of chemical factories. The technique hinges on (a) the distinguishability of proscribed emissions or their residues from background materials, having regard to the chemical changes likely to take place between the time of emission and the time of sampling; and (b) the sensitivity of proscribed-emission detectors, having regard to the size of samples it would be feasible to analyse and to the efficiency of whatever emission controls there may be. In general, the closer the point of sampling to the point of emission, both in space and in time, the less difficult will it be to overcome these constraints.

The serious possibility of the technique being applicable at least to nerve-gas emissions stems from the stability of the alkyl-phosphorus bond, the rarity of its occurence either in nature or in industrial commodities, and the fact that methods exist for detecting it at levels considerably below those that would obtain after passage through the most stringent emission controls currently in use. It thus looks as though it could become possible to give quite a firm positive or negative answer to the question of whether nerve gases are being manufactured, destroyed or tested at a particular site with no closer access than the site perimeter.

How might a technique having such a capability contribute to a verification regime ? It follows from what has been said earlier that there are two basic matters to consider: (1) How does the technique match up to the two criteria specified above: could it serve either to detect violation or to build confidence ? (2) If, as seems to be the case, the technique might increase the verifiability of a CW agreement, would it serve any useful purpose to specify its application in the verification provisions of the agreement ? Or would its value mainly reside in its availability as a national means of verification ?

As to the first matter, it has to be recognised that a move by one party to apply the technique to another party would amount to a declaration of suspicion, and thus be counter-productive in confidence-building terms. If, however, a party were to invite application of the technique within its territory, that in itself could build confidence. It would do so in inverse proportion to the number of geographical locations that were excluded from the invitation, and in direct proportion to the violation-detection capacity of the technique. That capacity is defined not only by the technical parameters noted above, but also by the probability of violation, if it were occuring, actually taking place within the sites at which the technique was directed. In a country of any size, the probability would certainly be low./ This is the first limitation of the technique. A second limitation is that the technique is adapted to detect only certain types of violation, viz production and testing of nerve gas; it could offer no assurance on clandestine stockpiling or, in its present state of development, on CW agents other than nerve gases. One might judge that the first limitation is much more serious than the second. It is true that the absence so far of any technique capable of detecting a violation of a stockpiling ban is at present a cause of concern. Yet unless it is seriously believed that the outbreak of chemical warfare is imminent, fears on this score are largely irrational since stockpiles of CW munitions have a strictly limited lifetime: the remedy therefore lies more in confidence-building measures than in violation detectors. The conclusion to be drawn is that near-site technique could satisfy both criteria, but only if applied in conjunction with other techniques that can compensate for the first of its limitations.

This conclusion bears directly upon the second matter to be considered. Near-site technique might significantly enhance the verifiability of a CW agreement but only if it could be used discriminately -- only if, that is to say, the technique were to be applied at sites which were thought to warrant such examination on the basis of indications received from other techniques. Such indications might derive from national technical means of verification. Or they might derive from the analysis of data obtained under the terms of an information-exchange / undertaking contained in the agreement. Either way, since the technique could be applied only with the concurrence of the suspected party, it could not enhance verifiability unless there were prior agreement among parties to accept its application. From this it follows that the technique can make one or other or both of two contributions to the type of verification regime

that might usefully be specified in an agreement. It might either be included among the battery of techniques available for investigating complaints under a verification-by-challenge procedure spelt out in the agreement. Or its application might be included among the activities permitted during technical exchange visits, provisions for which might be written into the agreement as a confidence building measure. In either case the special merit of the technique would be its low degree of intrusion into areas of legitimate industrial or military secrecy.

Conclusions such as these are, however, predicated upon the analytical methods available for use in near-site technique possessing an adequate sensitivity. That is the primary topic for discussion at the Leverkusen Workshop.

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I. Susiluoto (Finland) XXVII-34

DÉTENTE AND SECURITY IN NORTHERN EUROPE

1. General Remarks

Disturbance of détente - this may be taken as a fact - is due to a number of intertwined factors; technical, military, economic and political. The delay in the SALT negotiations reflects the unfortunate situation of technical development going way ahead of political control. Thus technical development continuously creates new political issues which are difficult to solve.

On the other hand, political programs have been put forth as if they were technical. This kind of technical "camouflage" can be discerned for instance in certain claims that the Soviet Union is far ahead of the United States in developing a particle accelerator capable of destroying satellites or incoming nuclear warheads and that this capability creates an unbalanced situation.

Technical development both in the East and West has its quantitative and qualitative asymmetries. The Soviet Union relies on massive quantitative armament (number of tanks, missiles throw-weight etc.) while the US is concentrating on the development of new technology and weapon systems. In these cases the development of technology

is creating different political issues, the solution of which is dependent on the relative importance attached to

a) immediate security of the parties involved

b) strategies of future technological development

c) long-range security perceptions (forecasts for 10 - 15 years)

d) time perspective in political decision-making (the importance of elections in the US, for instance)

e) economic consequences of different strategies.

Without going into details it seems evident that the Soviet policy of détente is based on certain economic calculations in which military expenditures and the welfare on the population are "optimized". The USA, however, is rich enough to be able to invest in armament and military technology without seriously disturbing the well-being of its citizens. As the USA is leading in many strategic technological fields the qualitative arms race is probably seen, on the Soviet side, as a more threatening issue than a quantitative one. Investment in new military technology may slow down economic growth and planned wellfare.

In the West the steady growth of Soviet military potential is often seen as an immediate menace demanding counter-measures. But because a quantitative increase in manpower and armaments has become very expensive the qualitative competition is seen

as a more convenient measure.

Quantitative-qualitative asymmetry in the arms race problematics is a kind of a vicious circle. In both sides different kinds of argumentation seem to lead to an objective consequence of accelerated arms race. This development is of course influenced by other factors as well. One may but mention the effect the Soviet and Cuban aid in Angola had on the US armament discussion, and the effect the Western "ideological warfare" of human rights has had in the Soviet Union and Eastern Europe.

2. Impacts on the situation in Northern Europe

The development sketched above has also had certain impacts on the security policy discussion in Northern Europe. Western suspicion of Soviet military intentions is most clearly seen in Norwegian attitude toward the growth of Soviet naval potential in the Artic Ocean and in the the Barents Sea. In Norway the argument has been repeatedly brought forward that the Murmansk naval base is the cause of basic military asymmetry in the North.

It is of course a fact that the Soviet Forces in the Kola area

are militarily superior to the Norwegian forces in the Tromsö - Finnmark area even when the NATO immediate reinforcement capacity is taken in consideration. The point is, however, that the Murmansk region cannot be estimated from the point of view of the Norwegian security question alone, or even the Western European security question alone. The importance of the Murmansk base for Soviet strategy is of a global nature. It has been estimated that 70% of the Soviet strategic submarine forces operate from bases in the Arctic. Therefore the only logical "balance" would be the Soviet Northern Fleet against the combined NATO and the US Northern Atlantic capabilities.

In Finland the Norwegian reaction to the Soviet "menace" has been watched with care. It is a well known fact that in Finland the Norwegian government's recent decision to let the West German forces take part in military exercises in Norway has been criticized. The criticism has been based on the fact that there has not been any conspicuous addition of ground or air forces in the Kola region in the 1970's. This attitude can be regarded as a conclusion of the way of thinking in which global and regional military questions are not automatically connected with each other.

According to this point of view global controversies should not be channelled to regional politics. Or, to say this an-

other way round, global "balance" cannot be achieved by regional means.

Seen from this perspective it is not rational for a very small actor in international politics to take an active part in a controversy, the result of which is certainly not under its own control. This is, however, the way the Finnish position has developed.

3. Restrictivness: key to continued détente

One might sketch a possible solution to the present situation in Northern Europe as follows. It is of course an open question whether or not this solution can be used elsewhere. Military asymmetry in the North should not be regarded as an obstacle to co-operation in other fields. This argument is based on the assumption that regional development is not, or should not be, automatically linked with global controversy.

If this assumption is accepted it will bring forward the following issues:

a) The "conditional" participation in military alliances (Norway's politics regarding atomic weapons and military bases is already to a certain extent

conditional)

b) fruitful regional economic co-operation in spite of global controversy. The North-Western parts of the Soviet Union would be a natural regional element in the development of Northern Europe,

c) restrictivness on the part of governments as to the internal affairs of other states. This refers to the "human rights" -problematics. It would be much better if the "ideological warfare" were not waged at the level of governments. This does not, of course, mean that the press, parties etc. could not continue their battles on "human rights". But governmental involvement in these affairs can lead to a serious slow down of détente without producing any beneficial effects.

These issues are intertwined and their realization may require simultaneous efforts in all three fields. This point can be made clear by a few examples.

The conditional participation in military alliances has been traditionally studied from the perspective of immediate military security. These "conditions" have often been understood as factors diminishing security. But if we take into account strategies of future technological development, long-

range security perceptions, time perspective in political and military decision-making and economic consequences of different strategies the calculations may be different from those based on immediate military security.

For instance the Soviet naval potential in the Arctic is probably going to increase because of global considerations. At the same time Norwegian interest in the natural resources of the northern continental shelf can be predicted to grow. This is due to future scarcity of oil and to the fact that Norwegian oil politics is, of course, of interest to Western European economies.

So far it is an open question whether the Soviet Union will concentrate on coal and oil production in Siberia and other inland areas or in the continental shelves. The Northern sea areas, inducing the Barents Sea, are, however, of economic interest to the Soviet Union too.

As an alternative to open military competition one might propose a solution of mutual "conditions" of military and economic nature.

An effort in this direction is facilitated by the fact that the security of Northern Europe is not determined by the superpowers and Norway alone. Denmark, Sweden, Iceland and Finland also have their role to play. The neutrality of Sweden and Finland and their experience in peaceful cooperation is of outmost importance when the question of Northern security is discussed.

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P.E. Hodgson (UK) XXVII-35

INTERNATIONAL SCIENTIFIC COOPERATION

Scientific research is a co-operative endeavour, and although each idea originates in the mind of a particular scientist it only becomes part of science when it is incorporated into the mind of the scientific community. Communications between scientists are therefore essential to the very life of the scientific community.

Scientists communicate with each other in many ways, and here we are concerned more with the informal side of scientific communication, in particular the letters we exchange, the discussions we have in our own laboratories, and our visits to other laboratories and to conferences to meet other scientists. We do not consider the more formal side of scientific communication through books and articles in scientific periodicals.

These scientific communications are of two broad types, firstly those modes of communication that are used by everyone, and secondly those special to scientists. Within each of these divisions we can consider firstly the obstacles in the way of easy communication and secondly the ways in which communication can be improved.

1. General Communications

(a) Written. Under this heading come personal letters, telegrams and telex. Letters are frequently used by scientists to communicate and discuss results, and to arrange joint research and personal visits. This can be hindered by censorship and by strikes, and by any other actions that delay or destroy the mail (1). Telegrams are very useful for rapid communication, and telex is also rapid and usually cheaper than telegrams. A disadvantage of telegrams was discovered by a friend of mine who tried to send a list of differential cross-sections by telegram from one country to another. The authorities thought that he was a spy and he had some trouble explaining himself to the police. Apparently it is forbidden to send coded messages by telegram.

(b) Spoken. The telephone is very useful for communications, but is usually too expensive for long distances. There is here the danger that the message could be listened to by a third party, although this seldom matters in scientific work. This danger even exists for personal

conversation in the presence of concealed microphones.

(d) Travel. Letters and telephone conversations are no substitute for personal meetings between scientists, and this can take place either at conferences, or when one visits the laboratory of the other. The financing of such visits raises problems that will be discussed below; here we are concerned that if finance is available there should be no other restrictions on such visits. In practice it is still found that visa and passport restrictions gravely hamper scientific visits. So much time can be taken up by the process of obtaining a visa that the visit is often abandoned. Furthermore, it seems to have been forgotton that a passport is a document issued to facilitate travel. The first page of my Passport reads:'Her Britannic Majesty's Principal Secretary of State for Foreign Affairs requests and requires in the Name of Her Majesty all those whom it may concern to allow the bearer to pass freely without let or hindrance, and to afford the bearer such assistance and protection as may be necessary.' Every citizen has a right to such a document, and to use it whenever he chooses to travel abroad. It is quite contrary to the concept of a passport that it should be held by the state, and only issued to the citizen after he has made specific application, giving reasons that the state deems sufficient, and then for a limited period, the passport to be surrendered to the state immediately on return. Thus a document designed to assist travel is turned into a means of restriction. Whatever purpose this serves, it is not that of scientific co-operation.

Currency restrictions also hinder scientific co-operation. I was once invited to give some lectures at a summer school, and I was promised that my air fare would be paid. I bought my ticket in England, and when I arrived my hosts said that they would pay me the equivalent in their own currency, which it transpired could neither be changed into pounds nor exported from that country. I asked what they suggested I should do with all that currency. They drew my attention to the peasant pottery of the country, and suggested that I might like to take some home with me. I bought some pottery, and most of it was smashed on the return flight. The wise summer school lecturer now asks for the prepaid ticket to be sent to him before he leaves home. This is also advisable in view of the new tax regulations in force in some countries (see below).

Travel is also hindered my numerous other restrictions, that in retrospect appear ludicrous, but which at the time can be very tiresome.

In one country I recall having to spend one of my two days in the capital (a day I could have well spent discussing science) applying for an exit visa. When at last I reached the head of the long queue the harassed official looked at my passport and announced that he could not grant me an exit visa, because there was no sign on my passport that I had ever been admitted to the country. Apparently some official at the airport had omitted to stamp my passport on entry. Luckily he had a sense of humour, or I might be there yet.

2. Scientific Communications

(a) Within a Laboratory. It might appear obvious that scientists interested in the same subject and working in the same laboratory will automatically spend some time discussing their work together, but experience shows that this is not always the case. There are many ways of stimulating such discussions that deserve careful consideration. It is very easy for scientists, particularly theoreticians who tend to work alone, to remain locked up in their own thoughts. A useful device to stimulate conversation is to arrange that coffee is served in the common room at eleven in the morning and tea at four in the afternoon. This ensures that the scientists meet together frequently and provides a natural occasion for discussion. In laboratories where the tea is brought round and placed on each scientist's desk the opposite is the effect. In one laboratory the co-operation between the experimentalists and the theoreticians (who were isolated in separate buildings) was greatly enhanced by the simple expedient of forbidding tea to be served in the theoretician's building. They were thus obliged to join the experimentalists, to the lasting gain of science. Scientific discussions within a laboratory can also be fostered by arranging seminars, lectures and discussion groups.

(b) Conferences. It is very desirable for scientists to meet at conferences, but this raises special problems due to the high cost and also to the physical impossibility of every scientist attending every conference that interests him. These problems are usually solved by restricting attendance to those invited by the organisers (who readily invite suitably qualified people), and by awarding the costs by means of a committee in each laboratory. Applications to attend conferences are considered periodically by such committees, and awards made taking into account the standing of the scientist,

the relevance of the conference to his work, and the need for the laboratory to be represented. It is also very useful if there are external sources of support such as learned societies, foundations, and central university funds.

(c) Visits. It is very useful for scientists to visit each other's laboratories to learn the details of the current work, and perhaps to undertake joint research. The length of such visits depends greatly on the circumstances. A young scientist can greatly profit by spending one or two years in another laboratory, learning techniques and carrying out research in collaboration with other scientists. For more senior people a visit of two or three weeks is often sufficient to lay the foundations, or to complete, some piece of research but if they can stay for a sabbatical year that is most useful A visit of a few days can also be most valuable for the exchange of information. For the financing of such visits it is essential that the person in direct charge of the research, the group leader, shall have the power to commit resources within clearly defined areas on his own responsibility without reference to higher authority in each instance. This enables him to react quickly when a suitable opportunity presents itself. For example, he may meet a scientist from overseas at a conference at a nearby university, and it is very useful if he can immediately invite him to his own laboratory for a few days, knowing that the costs of the travel and subsistence will be available. If he had to refer back for permission the opportunity would be lost. He can thus enjoy the opportunity of prolonged discussions with the visiting scientist without the difficulty and expense of paying the whole of his fare from his home country. Use of such opportunities makes it essential that such visiting scientists are not restricted as to their length of stay by passport or visa restrictions that only permit them to stay in the country for the exact duration of the conference.

A potentially serious threat to international co-operation by visits and attendance at conferences is now being posed by new tax laws in some countries that make all such expenditure liable to personal tax. Thus any grant for travel or living expenses is treated as personal income and is taxed as such. Since the cost of attending conferences overseas is often very high, this could have a very seriously discouraging effect on scientific co-operation (2).

(d) Permanent Links. Isolated visits are useful, but their value is greatly enhanced if they form part of a continuing co-operation between two laboratories. This implies that visits takes place , preferably in both directions, about once a year or even more frequently as the development of the co-operation requires. Such links between laboratories are often exceedingly fruitful, and are especially valuable for a smaller group, which can in this way raise the level of its research to that of a larger group. Funds for the specific purpose of fostering such academic links are made available by the British Council. It is essential for the growth of such links that the visits are decided by the needs of the research at that time, and this require considerable flexibility. Sometime there are proposed agreements for co-operative research between two laboratories on the basis of strict equality and symmetry of visits. This rarely accords with the scientific needs and could in most cases be harmful.

General Comments

The optimum directions for the growth and development of scientific research are generated within the research itself. It cannot be effectively directed from outside. Support from outside is essential, but this must respect the inner-directedness of scientific research, and thus leave the detailed allocation of resources in the hands of the departmental heads and group leaders who know the inner needs of the research from day to day.

It is unfortunately necessary to add that human freedom is now seriously limited in many ways, by restrictions on travel and emigration, by interference with the mail, by unjust tax laws, and this is gravely harming international scientific co-operation. To this may be added the not uncommon practice of excluding people of certain countries from research grants or travel-awards for reasons of a political nature that are entirely unconnected with scientific work.

In preparing this paper I have been greatly helped by discussions and correspondence with many past and present members of the Theoretical Nuclear Physics Group of the Nuclear Physics Laboratory of the University of Oxford, where we have tried over the years to foster international scientific co-operation (3). One of these colleagues writes in a letter:

"If co-operation is to be effective it needs to be supplemented by active official support. And this is exactly the role of international conferences on scientific policies, to draw the attention of the world (mass media, parliaments and governments) to the fact that science in general, and nuclear physics in particular, is unique. It is made by people who constitute themselves a community, regardless of their nationality, led by rules imposed by science itself. And in this scientific community one has to know each other, to share views and results, to work sometimes together, to establish plans of action, to criticise and be criticised. Those who do not understand these simple facts have to pay with ignorance and backwardness. Science cannot be either sold or bought. "

References.

1. The Medvedev Papers, By Z.A.Medvedev (Macmillan. 1970).

2. Physics Today June 1977.p.88.

3. An Experiment in International Scientific Co-operation. By P.E.Hodgson. Physics Bulletin.21.304.1970.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

A. De Smaele (Belgium)

XXVII-37

WORLD ENERGY PROBLEMS

Public opinion has been repeatedly told, since the end of 1973, that energy is in short supply. The argument has contributed to the aggravation of tensions in international relations.

In fact the problematic lies not in the lack of resources but in their uneven distribution, in theyr different economic worth, and in the present inability of producers and consumers to exchange the necessary guarantees of real cooperation.

Availability of energy sources

	Billion ton coal equivalent per year (10^9 T.C.E.)
Fossil fuel reserves - according to the best knowledge of geologists - amount to	± 10.000
Demand of primary energy in 1973 has been	7
Global demand over the next 30 years is not likely to exceed the total of	500
For long term needs other primary sources are available estimated at :	
- through fission	± 200.000.000
- throug fusion	± 400.000.000

plus renenvable sources as geothermal, wind, tides, sun.

Environment

The environment is modified by the transformation of primary energy. Some of the consequences can be taken care of trough appropriate technology; for others a ceiling has to be expected.

Though indirectly, plutonium availability is presently the greatest potential danger for society and for nature : options for control are being proposed.

Open pit coal mining raises environmental problems. Lignite reclamation in the Federal Republic of Germany offers a typical example of fertile land an landscape conservation.

Thermal pollution, according to preliminary analyses, should not be a real problem as long as the additional man'gs contribution remains within a few parts in a thousand of the earth's imput-output ($100'000.10^9$ T.C.E. per year).

Sharing of resources

The continuation for another 100 years of the global centennial trend (1870 - 1970) of energy demand, would bring consumption in to these fractions ($\pm$ 200 billion ton coal equivalent per year).

This horizon is necessary for an energy policy aimed at meeting the requirements of a population that will treble within the next century and whose disparity of specific energy consumption - evaluated at the level of 12 great world regions - is in the range of 100 to 1. The offer will have to meet both continued moderate growth of the industrialized countries and a significant more rapid developement of the others.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

R. Hauser (Australia) XXVII-36

A NEW APPROACH TO DISARMAMENT

1. The Heart of the Argument.
2. Reasons for the Present Impasse.
3. What to do about It.

1. The present atomic and social groundswell is a mirror picture of the most alarming crisis that humankind has ever faced. Paradoxically, because of the many attempts made to force people to confront the horrors of overkill, fewer and fewer people are able to face the reality - one cannot frighten anyone into reason. In fact, the mounting pressure of mutually uncontrollable anxiety has in itself produced a vast layer of apathy, of pessimism and unless this mood is dealt with as a major danger in its own right, the prophecies could become self-fulfilling.

Many of the experts themselves, although worried out of all proportions if they have a conscience, are becoming acclimatised to an ever lower standard of humanity. Whilst living orderly and often undramatic daily lives as normal fathers, husbands, friends and colleagues, they rationalise the killing of 100-120 million people at the first strike.

It is useless to say how evil and irresponsible people are because we are all caught up in a system which impels us on and on like the sorcerers apprentice. Both super-powers are controlled by the same forces. The main enemy is the prevailing mentality which is old-fashioned, which appeals consciously and unconsciously to our faith in super-powerful leaders to intervene so that the film ends well, and relieve us of all responsibility. The means used is the manipulation of anxiety by playing on the threat that the other side will strike first. The situation is susceptible to rapid deterioration and the coming to power of a demagogue, a daddy surrogate, who could deliberately provoke genuine or fake threats from outside the borders justifying a uniting of warring factions under him and thereby destroying any potential opposition. Unless people are helped to grow up and become responsible the prospect of loosing their 'daddies' will increase their anxiety. The replacement 'daddies' could be more primitive and ruthless than the original ones and impose their brutal leadership by stimulating further anxiety in order to justify the sacrifice of civil liberties.

Where reality becomes too painful to face, as was shown in the Hitler period when it was clear to his Generals that the war was lost, irreality takes over. When fantasy takes over in individuals it is seen as a serious mental disorder, i.e., the groundlessly jealous husband, murderer of tomorrow, the millionnaire who feels penniless because he is down to his last million, the drug addict who pays heavily in real life to return to his fantasy life, whereas in the case of minorities or nations, similarly caught up in unreality, a certain measure of "acclimatisation" is taking place amongst the people who are becoming more and more paralysed by the apparent normalcy of the situation. Everybody shows signs of a split personality ambivalence whereby on the one hand they know the train is moving towards disaster but on the other hand they cannot jump off and don't know how to stop the train and therefore refuse to face the problem.

In the last 20 years outstanding and brilliantly informed bodies, like SIPRI, have tried to warn those who are willing to listen. Disarmament experts, like Philip Noel Baker, Sean McBride and others have added their cries of alarm and attempted to clarify the issues. But in spite of all this the vast international dialogue of the fifties and sixties has been stilled. Every time an even more horrifying weapon is announced more people flee into cynicism, hopelessness or the joy of private life. Those directly involved in the armaments race who know the dangers best are often themselves in a terrible impasse - be they scientists, politicians or generals many find themselves in a conflict of natural and professional loyalties and moral obligations. However well-meaning they might be, they too cannot jump off the train - they are themselves part of the incipient social madness. Those who refuse or who are unable to be manipulated (by pressure, threats or corruption) also do not have the means to effectively challenge either the power leaders or their servants - the communicators of the establishment.
The only means available when power clashes with power is mutual blackmail. Fixing a ceiling (SALT) may perhaps slow down a little the arms race but for power the unforgiveable sin is weakness. Influence, the only factor that can stand up to power, is now being used negatively to manipulate the minds of people, often against their will but mostly without their even being aware of this.

The art or "science" of manipulation of the mind has been developed to a horrendous degree with new technological means of communication and a lack of strong value patterns. Even the most humane values can be counter-productive if imposed and manipulated. Yet in no university or place of learning is psychological warfare being taught - the manipulators work secretly as thieves in the night.

If we want to change the social climate from anxiety and terror we have to face a whole gamut of problems, including the parallel set of problems arising from the disintegration of time-honoured social structures, such as the extended family. Many countries are in a situation of galloping social breakdown. A revolution without revolutionaries is producing more changes in a matter of years than happened in centuries before. The attached list of 57 crises shows that many are of a new type having no historical precedence. However, we cannot envisage a breakthrough in the social climate or in the minds of men until the life-promoting influence of women makes itself felt by pressing for a new social and educational order based not on the superiority of one superman over another but on the common will to live and to let live. This can only come about if the motivation for leadership is responsibility and not power as the taking on of responsibility is the main factor that makes men, women and young people mature.

2. Reasons for the Present Impasse.

1. The Breakdown of Paternalism constitutes a severe blow to the value system which was based on fear of and trust in the big Daddy and his staff. In most cases Daddy has not yet been toppled but the system, like feudalism, is disintegrating because it has become obsolete. The paternalists who are still trying to prop up the system do so by re-appointing themselves as elites into which are easily absorbed emerging new power leaders.

2. The old values, guilt, sin, punishment, evil, blind obedience to higher authority have been very much weakened. Only deeply religious persons or orthodox psychoanalysts believe in these any more. The axis around which these values evolve was a vertical one emanating from the highest authority and in theory affecting the mighty and lowly alike. This vertical axis has now been replaced, without the philosophers having planned for it, by a horizontal axis, dangerous because it does not relate to a moral model, but draws its approval from the peer group. The peer group dictates the type of behaviour expected from its members and the worst deterrent is contempt, hostility and finally exclusion; it is preferable to do something that one cannot defend than to be seen as a traitor with all the risks involved. On the one hand a feeling of success and dignity derives from being an accepted part of such a peer group and on the other a feeling of loneliness and vulnerability from the anxiety of being excluded. Of all these negative pressures, ridicule is the strongest. The negative aspects of this low-level shame culture lead easily from a-responsibility (apathy) to irresponsibility (violence).

3. Lack of Preparation for Life. Social or generalist eduction was never the primary purpose of school or university. The extended family and other social structures, e.g. the church, neighbourhood and the community whose responsibility it was to prepare young people for adult life, are being destroyed in the developed and in the developing world where there is a strong movement from rural areas to urban areas. Deprived of the support of traditional experience and of the means of developing new purpose and meaning, these uprooted people find themselves easy prey to negative manipulators.

4. Social Infantalism. The social pressures of grossly undignified conditions cause people to protitute their dignity and common sense. Sometimes highly intelligent people stricken by a feeling of personal vulnerability conform to their mandatory duties and like small children become totally dependant. The mighty General, important politician, brilliant scientist press the button to kill and by this action are as ruthless as a small child with a gun who shoots because he cannot identify with the other side. Wassermann called social infantalism the inability to imagine the same happening to their loved ones the <u>laziness of heart</u>.

5. Influence block by Anxiety. The very size and drama frightens people away. Even the influence leaders (those who try to change the social climate)actually push us closer to the abyss by producing more and more anxiety and paralysing the willingness to fight.

6. Absence of a Moral equivalent for War. Let us not be in two minds about the morality of a defensive counter strike or of a balance of terror. There can be no winners in an atomic war, and there will be no second chances. It is not true that unless we kill others first they will kill us. There will inevitably be conflict but it must take on humanised forms. Whereas violence pushed to its limits results in mutual death, social aggression, the constructive alternative to violence, is necessary to challenge the injustices within the world and as a tool of liberation against oppression and of freedom to develop to our full potential is apositive force. The battle is between the forces of life and the forces of death, between violence about which the experts know so much and social aggression - a field in which we are all learners.

7. Machismo. This is the power drive to possess and destroy. It is a state of complete irresponsibility in which the most powerful weapons are but an extension of the male's sexual drive. The rivalry which has caused old paternalists sending younger men out to die has propelled to a total madness in which the destruction of the entire world is imminent. We live in a wartime economy hypercritically to prevent a war and thereby reduce most of the world to hunger, torment, violence and anxiety. The obvious contradiction between the waste involved in the over-production of military devices and the extent of unsatisfied vital needs is in itself an act of violence against those who are the victims of it. This uncontrollable machismo is the culmination in a machine gone mad of a continuing infection which killed 20 million Russians in the second world war, millions of concentration camp victims and continued in the shape of Stalinism, Vietnam, The Cold War treatment of minorities etc. We are well on the way to psychopathic super madness when it is possible to talk of "500 people dead being a tragedy and one million people being statistics."

3. What to do about It.

So much of what has been said and attempted so far was based either on gesture (challenging authority, demonstrations) or moralisation (preaching at power). Those involved in disarmament often spoke to their own condition and that of their peers but did not try to understand the fears and anxieties of the atomic power leaders.
The sword of Damicles is hanging over our heads and once this removed all other issues will be comparatively easy to handle. The invisible battle is about the will to live and to let live. Top priority is to banish the death wish as expressed in neutron bombs, poison bombs, nerve gas bombs, terrorist bombs etc. To take action which will result in children being born as cretins, without palate, without organs, deformed, blind, deaf is a risk that no President of whatever country can possibly get away with calling politics.
Behind the impending nightmare of holocaust lie hopeful forces waiting to be released to create a completely new society where where social maturity will replace social infantalism.

To reverse this downward spiral will not be easy and one or two pet answers will not suffice. Humankind is always at its best in times of tremendous challenge provided they do not panic backward into apathy or forward into senseless violence. An attack on our whole way of thinking, acting, surviving and living is possible if we are prepared to learn that the way forward does not lie in smashing up or patching but in making the development of a new spirit a top priority.

We urgently need value carriers in the battle for future generations. as Robert Jungk says in our advocacy for the unborn. These should be minimum value carriers concerned with basic universal values, stimulating people to establish basic common standards of responsible behaviour below which they would consider it shameful to have fallen. Voluntarily chosen and carefully considered social burdens (unlike duty which is imposed) provide the stimulus for social growth.

Comparative studies need to be undertaken at all levels of society so that every group has the necessary tools and measurements to isolate, compare and to learn from the symptoms of their conflicts, how to liberate themselves from the negative and how to free themselves for the positive in common with all others. Already a tremendous awakening is taking place at grassroots level showing that the basic common denominator that we all possess is common sense. If people are enabled, not just taught to unlearn the prototypes, stereotypes and socio types which control their minds they can easily regain the capacity to foresee and to forestall the consequences of human invention, a capacity that Albert Schweitzer believed that man had lost.

Specialists are useful but they should be controlled by the common sense of "ordinary" people who do not wish to starve, torture or to bomb their fellows out of existence. There are 400,000 scientists working on machines of destruction and their lack of common sense speaks for itself. It is only by involving everybody in a drive for life that the will to live which is so strong in everyone but which has been suppressed by terror and prediction of doom will open up a new era of social awareness hopeful enough to dispel the nightmare of wholesale atomic destruction.

Proposals for a social change of climate:-

It is proposed that an International Centre for the survival of humanity be formed.

Its prime purpose will be to enable people to face the reality of the growing danger of atomic and other forms of super warfare, which may build up to irreversable conflict. Hopefully the power-leaders will approve, but in any event the proposed Centre must be based on the will of the people.

Equally important is the change of social climate, to find different ways of changing the negative, hopeless and pessimistic feelings in people; as apart from total nuclear disarmament, which is too far away to consider, there is no single answer. Hopelessness must be fought; goodwill is not enough, nor is information regarding the latest weapons. This policy has been shown to be counter-productive because it frightens people away. Even activists have been frightened away, there is now hardly any public dialogue. There is an increasing feeling of doom, so that matters are being left in the hands of experts, who must feel overwhelmed by these problems. In order to produce high morale it is not enough to just manipulate; it is necessary to help people to understand what they can do about it so that they do not panic. Accordingly a special section of the Centre is suggested for disbanding the balance of terror.

(Proposal I., sub section A

In making these proposals we are very much aware that there are other extremely important factors contributing to the danger of being killed by the atomic bomb - a lack of basic human rights, such as hunger, Third World inequality and poverty.

It is essential that we mention the disintegration of the old paternalistic structures which hardens the difficulties of the social climate. It is not possible to deal with this subject, at this stage, within this paper.

It must be said at the outset that we are all learners and the writer is surprised that comparatively little interest

has been taken, beyond the holding of opinions. These should not be mixed up with psychology which is mainly the study of the personal psyche and understanding small groups (with notable exceptions). Sociology, mainly concerned with a rather academic analysis without synthesis and action.

A special study is proposed of life and death drives. This being one of the underlying themes, i.e. the will to live and let live. (I., sub-section B).

Additional studies are proposed to include the study of violence , and its' replacement by controlled Social Aggression. (I., sub-section C).

It is my firm conviction that had there been better understanding and better tools we would not be in such a dangerous mess. However these tools and techniques must be available to all for a proper generalist approach.

It is very important that whatever dialogue takes place in the preliminary stages by experts, will not produce a barrier to the catalysts and leaders who can bring this understanding to the great majority. At the same time these approaches must be interesting and provocative enough for effective mass comunication.

Immediate headings will have to be based very clearly on the idea that:-

I). When additional news and information of new weapons is available, the news should be produced in such a way that intelligent fear can produce healthy indignation and social structures, resulting in minimum anxiety. This in itself is a very important task which is being disastrously mishandled.

2). The enemy today is not"the other side", but atomic warfare which while existing mainly on two major sides is equally endangering for them both, as well as for the rest of humanity. The fight against this incubus must be shared.

3). There will be members who might be interested in the main challenges and wish to see them treated parallel or together:-

(a) Atomic or other armament dangers.
(b) People dying of hunger daily, who could be saved. (They are just as dead as if killed in any other way).
(c) The lack of human rights and minimum values necessary as a minimum common denominator of human behaviour.
(d) Welcome disintegration in many countries of old paternalistic forms, with nothing to put in their place.

Obviously these and certain other factors (See Paper on 57 crises), are in themselves in need of study to see how and where they overlap and how one needs social planning to fight back. Accordingly it is proposed that an Educational Programme be evolved, to work within schools, Universities etc.. to enable people to understand, and to share their understanding, as generalists and also specialists in psychological warfare for war; invisable warfare for peace, to appreciate and be able to resist manipulation. These studies to include an examination of scapegoatism, torture, corruption in the arms trade, action research tools and tools and techniques of mediation and conciliation. (Proposal 2).

Action Research in itself calls for another Paper, however it would include pilot programmes for testing the tools repeatedly, in selected areas on a transnational basis. (2., sub-section I).

4). The preparation and handling of possible emergencies. This question is most difficult to deal with, and above all to prevent such accidents as a bomb going off in its country of origin; a missile being exploded in another country (by contrived accident); outside small powers or terrorists taking control of atomic power stations and of course the possibility of holocaust. Any primitive approach should show that the stock answer that nothing can be done by way of civil defense is unacceptable. Even if a million people were to die in the epi-centre, with huge numbers dying just beyond it, there will be many wounded, scared, blinded, dying shortly afterwards. Food

and water contaminated. It must be obvious that one must prepare, such preparation waking up the population to the dangers, better than anything else.
Accordingly it is proposed that Atomic Rehearsals take place showing how we would act, even though a simulated situation. It is further suggested that Civil Defence Units are trained. And that An International Warning System - 'A Red Alert', is arranged at a civilian level to allow for an accidental atomic catastrophe. Additionally it is suggested that a Resource Centre to assist the watch tower function in the proposed International Centre be incorporated so that all relevent conflict material can be collected and acted on. (Proposal 3., sub-sections I,2 &3).

5) There is a need to study tactical atomic bombs which may be used to destroy troops and civilians at the border area; neutron bombs which kill people but leave the landscape accessible to an invading army; the psychiatric bomb which does not kill but drives people irreversibly mad so that they will die horribly, even killing each other. No doubt there are other such contributions for mankind in store by the mad scientists. Accordingly it is proposed that a feasibility study takes place to consider the use of Zones of Protection, to see which categories of people could be given protection during military action. And the use of War-FREE Zones the equivilent of open cities where no civilians would be involved, no missiles or military units withina 50 mile radius. War Zones being the opposite to War-Free Zones wherein warfare would take place. Additionally it is suggested that Special Units, being a constant and permanent force of underground resistance, opposing any occupying force, be organized. (3., Sub sections I, 2 & 3).)

The debunking of infantalism. This is possibly the most dangerous part for those representing the present mentality. The present crazy nightmare results in much of the anxiety which hinders people from facing the problem.

Anonymity helps a killer. More and more forms must be found to show what people have in common, and how comparitively small is the sphere of conflict that may lead to death.

Humanized conflict forms could well allow for social growth of the participants, leading towards a new society.

A societal audit is needed. This should be given to the study of social pathology i.e. the psychopathy of the sick killer instinct at the following 4 levels:-

(I). Attempt to escape from any knowledge - pushing problems into sub-conscious, resenting being reminded.

(2). Passive psychopathy where one can accept the death of millions without doing anything about it.

(3). Active psychopathy where people commit the most heinious mass murders e.g. by pressing the atomic warhead button without identifying with those children who will be born with disturbed genes, sick brains, no palates or sex parts.

(4). Complete alienation - when people lose every sense of themselves and their surroundings, are permanently panic striken and incapable of looking after themselves resulting in complete de-humanization.

Therefore it is proposed that a Planning and Socio-Audit Unit be used to study this question. (Proposal 4).

A study to understand and handle these problems which take place in perfectly "normal" people is essential. We must find ways of:-

(I). Bringing knowledge out of the sub-conscious which has resulted in people feeling trapped and helpless.

(2). A turnaround is needed to reduce apathy and violence. (Apathy often being frozen violence).

(3). Training of catalyst trainers - on the highest level to help when top power leaders are in a situation leading to eyeball to eyeball confrontation, and where they wish desperately to find an "honourable" way out which only a catalyst can produce.

(4). The study of such problems well in advance and the establishment of a high powered influence body could be all important.

(5). The same, or another body should also be concerned to find catalysts on every level of society to face this challenge. It is the biggest challenge of all; if we can overcome it, the other challenges can be overcome equally constructively to show new societal patterns.

But it is all important to find new tools with the people as the jury, whose common sense will always decide for life, to live and let live. Man has always been at his best when confronted by great hurdles, provided he is prepared to see them as unaviodable challenges beyond which lies a chance to live a completely new life. All people will need skills to understand the dangers and to deal with injustice on local, national and international levels.

Accordingly it is proposed that 3 interdependent units are created as follows:-

International Monitoring Unit on Anxiety.
International Influence Structure.
Planning & Socio-Audit Unit.

(Proposal 5).

9). Special care should be taken that the young have their say. It is their future and lives as it is of their born and unborn children. Robert Jungke proposes an advocate for the unborn generations. This may well be the young themselves, giving them an obligatory subject to study, so that they know fully all the dangers and what they can do; seeing human rights and responsibilities as minimum common denominators which effect their environment as much as international dangers. Thus it is proposed that a Youth Programme preferably devised by the young for the young come into being.(Prop 6).

Machismo:- (Male superiority drive, often directed against other weaker males but always the result of the lack of female input.) The gun for many is like the male sex part;

so it seems is the bomb. Machismo is the most essential part of paternalistic superioty over the masses, as it is the scapegoat thrown to them to distract them from fighting to change their conditions.

The challenge of nuclear power stations should be fully understood. People who cannot face the fact that one multi-headed missile can destroy 5 cities with millions of people can face the danger that nuclear power stations present. Apart from the inherent argument over nuclear power stations, the danger can be illustrated to people by showing the problems mentioned earlier if power stations are seized etc..

It is suggested that there should be a body operating as a watchdog, keeping track of the sharpening or deterioration of conflict areas, which may lead to holocaust.

(Proposal 7).

We would further suggest:- A special body of distinguished people who would award a "Noble" Prize to those most helpful to peace and disarmament.

(Proposal 8).

The technical fight must of course go on; but this approach may enter peoples imagination, especially with the activists, and should then be widened more and more so that this night-mare can be barren foreever.

It cannot be emphasised enough, that all this must be done with the will to live, with joy and open determination and as a challenge for a new society. It is all important that mans will to live and let live triumphs over infantalism or social reptilism, and his anxiety about death and therefore his ability to kill.

This is the biggest battle, and as wars start in the minds of men, so can peace.

If action to produce a new social climate can be successful the problem should become much easier to handle. If we can win this battle for survival, and the invisable battle against social infantalism and social disintegration, plus the visable battle against hunger and injustice, then the need for new social forms will be achieved and won.

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15 July 1977

Information Circular No. 2

To : Participants in the 27th Pugwash Conference, Munich, 24-29 August 1977

From : M.M. Kaplan, Director-General

1. Working Documents

Enclosed in the last batch of working documents you will receive in advance by post. Additional working papers, submitted after 15 July, will be distributed at the Conference itself. Working papers brought to the Conference by participants will, if possible, be reproduced and distributed during the first two days of the Conference. Please hand them in on arrival at the registration desk in Hotel Bayerischer Hof. Working documents should be typed in $1\frac{1}{2}$ or double spaced lines. The original copy should be submitted and should be as short as possible (a few pages). May we remind you to bring all documentation with you.

The May 1977 issue of the Pugwash Newsletter and a special Newsletter supplement by J. Rotblat on the history of Pugwash 1972-1977 have been sent to you under separate cover.

2. Transport

Participants arriving on Tuesday 23 August will be met at the Munich airport and central railroad station by assistants who will help with transport to the Hotel Bayersicher Hof. Those arriving on other days should make their way directly to the hotel. You will be assigned rooms in the Bayerischer Hof or in nearby hotels where accommodations have been reserved.

Mail for all participants should be addressed to:

Hotel Bayerischer Hof,
Promenadeplatz 2-6,
8 Munich 2.
F.R.G.

3. Programme Notes

Please refer to the programme enclosed with information circular No. 1.

a. Opening Session

It is probable that Chancellor Helmut Schmidt will open the Conference.

Hepzibah Menuhin, pianist, will give a short concert at 9.30 a.m., immediately preceding the official opening of the Conference.

b. Introductory speakers for plenary session II will be Professor A. Chayes (USA), Dr. E. E. Galal (Egypt), and Academician M. A. Markov (USSR).

c. The panel speakers for plenary session V consists of the following:

A. T. Balevski (Bulgaria)
B. T. Feld (USA)
I. M. Frank (USSR)
Philip Noel-Baker (UK)
M. Perez-Guerrero (Venezuela)
A. Rahman (Egypt)
T. Toyoda (Japan) on behalf of Hideki Yukawa
C. F. von Weizsäcker (FRG)

Two additional speakers have been invited and their answers are awaited.
Professor Dorothy Hodgkin will serve as Moderator for the panel.

4. Working Groups

You will be notified on arrival to which Working Group you have been assigned. We have tried as far as possible to follow your wishes in this connection, but we have had to keep a balance in numbers of respective working groups.

5. Exhibits

A special exhibit will be mounted in the Hotel Bayerischer Hof of sculptures, and their designs, of Russell and Einstein. Mr. Chattaway the sculptor will be present. Also, specially minted medallions based on these designs and produced by the Bulgarian Pugwash group will be on display Profits from sale of these items will be allocated for support of expenses of the Central Office.

Pugwash publications will also be available for sale.

Welcome to Munich.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

F. Calogero (Italy) XXVII-7

A NOVEL APPROACH TO ARMS CONTROL NEGOTIATIONS?

"We must move to secure agreement with the Soviet Union on a quick freeze on the number of atomic missiles and warheads, total throw-weight, and qualitative weapons improvements. Then - and we have never tried this - we must move towards methodical, step-by-step mutual reductions in our atomic arsenals, maintaining at all times rough equivalence in destructive power".
Speech by presidential candidate Jimmy Carter, October 14, 1976.

"We still consider that improved Soviet American relations, that the strict implementation by both sides of the relevant treaties and agreements they have signed in recent years, and that the signing as well of new agreements which would consolidate and continue the course that was started in 1972 and 1973, are all tremendously important. The successful elaboration of a new agreement on strategic arms limitation, which is being dragged out, would also be very important As before, the Soviet Union expresses its goodwill and its constructive approach to this question". Speech by CPSU General Secretary L.I.Brezhnev at the meeting of Communist Parties in Berlin, June 1976.

1. In the arms control community, and in public opinion at large, a certain disillusionment with arms limitation talks is emerging. It is motivated by the costive progress of these negotiations, and by the recognition that the very process of ongoing talks effectively fuels the arms race - mainly via the "bargaining chip" mechanism.[1] This uneasy feeling is reinforced by the observation that several distinguished hawks have now found it convenient to dress up as arms controllers, evidently finding such a posture the most advantageous one to promote their point of view concerning weapons acquisition (that one way or another always presses for "more" -quantitatively and qualitatively).

2. Yet it is generally recognized that a reversal of the present course, characterized by unrestricted qualitative competition and enormous strategic arsenals, could hardly be achieved without a breakthrough in the negotiations; while the continuation of this trend heads towards disasters, sooner or later (and most likely sooner than later). Such a breakthrough appears moreover as a necessary - if by no means sufficient - condition for coping with the other disruptive developments associated with technological "progress", among which stands out as particularly troublesome the worldwide spread of nuclear materials and technology, with the associated risks of nuclear weapons proliferation. Indeed these problems would require a coherent cooperative initiative by the Superpowers to move towards that "novel world order" needed to avoid the assured occurence of major disasters within the next few decades. But such a joint action is unthinkable unless the main dynamism of the bilateral strategic arms race is brought under control; a goal hardly achievable without arms limitation agreements.

3. The present situation certainly does not justify any optimism; indeed the runaway character of the strategic arms race is dramatically underscored by the recent advent of the cruise missile. Yet the objective urgent need for substantial arms control agreements is now associated with some circumstances that should facilitate the attainment of such a goal: there is rough parity in the strategic field (although characterized by asymmetries in the strategic postures of the Superpowers); the strategic overkill capacity of each Superpower is so huge, to make any other country, including China, essentially irrelevant to the substance of any arms control agreement that might be realistically envisioned now; the efficiency of "national means of verification" (mainly satellites) has made verification (a traditional stumbling block in disarmament negotiations) essentially a non-issue (although this might be put into question by the advent of the cruise missile).

But the crux of the matter lies in the "political will" - of course, on both sides. Clearly any optimism solely based on utterances such as those quoted at the beginning of this paper would be naive; but it would be no less foolish to ignore the present existence of considerable pressure on the decision makers, to move ahead towards the goal of checking, perhaps reversing, the arms race momentum. An important component of this pressure is of course economic; moreover, a strong personal committment on the part of the chief decision makers is probably motivated by the recognition of the dangers ahead. Indeed the very fact that the hawks tend to disguise themselves as arms controllers does indicate that the political climate vaguely favours arms control.

4. Why then, if there is political will, no substantial progress in arms control has thus far occured? Obviously, because of the difficulty to negotiate an agreement; one that each decision maker could buy,and sell, in his political environment.

It is therefore useful to try and understand what are the obstacles that stand in the way of an arms control agreement; techniques to overcome, or bypass, these difficulties could then be devised. This is the main purpose of this paper.

Before proceeding with the analysis, let me however reemphasize that no technical gimmick can replace the lack of political will. But the amount of political will available might be sufficient to bring to fruition a negotiation that has been devised so as to avoid the main difficulties, while it may instead be insufficient if such forethought has not been operative. (A classical example of a goal achievable only by an appropriate choice of the means is the following one. Suppose that a government wanted to convince, or force, all shops, factories, offices, etc., to open and close one hour later in the summer. Clearly this task would be terribly cumbersome, indeed certainly politically unfeasible, if this goal were pursued issuing a collection of ad hoc regulations; while the simple technique of introducing the "daylight saving time" just does it, with so much less effort to make the operation actually feasible - if not altogether painless).

5. The strategic postures forthe two Superpowers are characterized by major asymmetries. There are geographical differences; differences in the types, performance and numbers of strategic weapons; differences in the socioeconomic and political structures. From these asymmetries originate much of the difficulty of reaching an arms limitation agreement; for while the decision makers on both sides may now recognize the need to settle for strategic "parity", how is this concept actually to be implemented, when the specifics of what to limit and eventually reduce have to be nailed down in an arms control agreement? A balanced agreed choice in an asymmetric situation is obviously difficult; indeed the attempts to develop an "objective formula" to measure "strategic power" as a function of different indicators (aggregate throw-weight, number of warheads, "accuracy", vulnerability, etc.) appear doomed to failure. For the fact is, that such an "objective" formula does not exist; moreover, any hope to develop one by consensus is thwarted by the conservative attitude on both sides, that assesses any proposed balanced limitation on the basis of highly biased "worst-case analysis"(2). Thus arms control and disarmament, that should be considered a non-zero-sum game with overall positive payoff, is viewed instead as a non-zero-sum game with overall negative payoff. A truly balanced proposal is perceived as disadvantageous by both sides. This is not conducive to progress.

Indeed, even if an agreement is eventually achieved - and under the circumstances this does require a lot of political will - it is then liable to criticisms that, focusing only on those asymmetries in which one side appears at a disadvantage, conclude that the agreement has been a dangerous sell out. Visible asymmetries written in any agreement, justified as they may be by considerations of balance, thus provide the most convenient ammunition to the hawks, eroding the political support for the agreement, that is essential for its acceptance, implementation and follow up. This phenomenon has been quite evident in the US political debate following SALT I.

Thus one should aim at symmetrical agreements. One (successful) example has been the ABM treaty in SALT 1. But arms control has to cope with unsymmetrical situations; how can agreements, that must eventually get down to the specifics of what to limit and what to reduce, preserve the appearance - and substance - of symmetry? One (unsatisfactory) example was given at Vladivostock; it is (essentially) tantamout to giving up altogether the main goal, i.e. arms limitations (not to mention disarmament!).

6. Another difficulty has to do with the presence, within the decision making process of each Superpower, of influential sectors that are opposed to arms control. These include military and economic groups with a vested interest in the expansion and open-ended modernization of weapon systems, and people who regard any agreement with the "enemy" as some sort of appeasement. While it would be difficult for the representatives of these points of view to oppose openly a policy decision to work towards a disarmament agreement, it is easy for them to impede progress by creating difficulties in the negotiations; this is especially easy at the stage when the specifics of what to limit and what to reduce must be pinned down.

A related difficulty has to do with internal rivalries within each country, especially between different military sectors. Indeed, even military chiefs who are not a priori opposed to disarmament are likely to prefer that cuts be made in other sectors than thier own: the Navy is likely to view with more equanimity limitations on ICBM's than on nuclear submarines; the Air Force would probably be less adamant in opposing limitations

on carriers with nuclear-armed aircraft than on land-based nuclear bombers; and so on.

The end result of all these pressures is a much stiffer negotiating posture. In fact what happens is that the leaders of each superpower are pushed into trying to convince the other side to make some concessions, to allow them to overcome their internal problems. But here the situation is indeed symmetrical; for the same sort of difficulties are undoubtedly present on both sides. The result is what we see: no progress.

These difficulties arise mainly when the specific terms of a disarmament agreement are debated and a decision about what to limit, and possibly cut back, must be made. Should then one not try and circumvent this most difficult aspect of the negotiation?

7. Is it possible to devise a procedure to assess the strategic balance in an objective way, that might be acceptable to both sides and that would be least subject to the criticism of favouring one side? Is it possible to devise procedures to decouple the internal debate in each country on the assessment of the relative importance of different components of the strategic posture, from the negotiation with the other side about what specifically to limit and to reduce by international agreement?

If this paper stimulates some thinking towards answering these questions, it will have served its purpose. Indeed it seems to me that up to now insufficient attention has been given to the possibility that a change in the format, and aim, of arms control negotiations and agreements, might facilitate progress. In the following I will outline one such suggestion; but I believe that more important than this specific proposal is the emphasis on the questions I have just raised; since no doubt others might come forward with better ideas.

8. A (somewhat idealized) example may be the best way to introduce the kind of suggestion I have in mind. Imagine an archeological expedition making a campaign of excavations in a foreign country, on the condition that one half of what they uncover can be exported, the other half having instead to be left behind to be displayed in state museums. At the end of the campaign the archeologists and officials of the host country meet to divide the bounty into two parts. Both have the best intention to implement the 50-50 agreement (the "political will" is there!); yet should they start a negotiation to divide the material in two "equal" lots, they would be faced with a very difficult task, most likely to result in stalemate and bitterness. How to divide fairly a collection of assorted items - statues, vases, etc. - that do not come in equal pairs and whose value is very hard to define? Note that even between the archeologists there would certainly be highly disparate judgements, depending on their professional interests and personal tastes; and this would further complicate the negotiation. Yet a very simple trick bypasses all difficulties: the archeologists divide all the material into two lots, exercising their own independent judgement (and if need be, fighting out their own differences); then the officials of the host country, exercising their own judgment, choose one of the two lots. The matter has been settled bypassing altogether any negotiation!

The same sort of idea solves the problem of dividing a pie between two children;

we have used the archeologist example because perhaps it mimics less roughly the arms control problem (for one thing, it indicates the applicability of the concept in an international context!).

The serious point of course is: can one imagine anything similar that would be really applicable, say, in the SALT context?

9.I have indicated elsewhere how such a disarmament scheme could be envisaged(3); I report here a terse outline of this proposal.

The situation is of course considerably more complicated than in the archeologist example. For one thing the assessment of the available strategic arsenals is itself a contentious issue (including the very definition of "strategic forces": should the cruise missile be included? the Backfire? FBSs?). Moreover one should not envisage a one-shot affair (like the 50-50division in the archeologist example), but rather the setting up of a gradual disarmament process, such as to guarantee at each stage the maintenance of security.

Yet all these problems can be overcome by taking advantage of the "negative feed back" idea implicit in the archeologist example: the trick consists in devising a procedure structured so as to discourage any unfair behaviour by making it unprofitable (such as, in the archeologist case, would be a division of the bounty into two unequal lots - since the best one would then be chosen by the other side). The basic characteristic of such a procedure, both for the assessment of the strategic stock available to each side, and for the selection of the items to be deactivated as the disarmament process unfolds, should moreover be to proceed only via "unilateral" decisions (to avoid getting bogged down in negotiations); each move being however imbedded within a process devised so as to discourage any "unfair" choice by rendering it effectively disadvantageous.

The scheme might proceed as follows. Assume first a basic political decision to have, say, 5% disarmament each year for, say, ten years (exponential rule: this would induce very gradual disarmament, leaving after ten years about 60% of the initial stock). What specifically to reduce would then be identified by the following procedure. First each country would provide an inventory (based on its own assessment) of the strategic forces of the other country; a "value", represented by a positive integral number not exceeding 10.000, would be attached to each item, so that the total "value" adds up to one million. Then each country would partition its own forces (those included in the inventory presented by the other side) into 80 lots, so that the total "value" of the material in these lots be 800.000; a limit to the minimum "value" of each lot could be established (the mean value would of course be 10.000). Finally a number of lots - say, six - would be selected for deactivation; some of them (say, two) would be chosen by the other side, some of them (say, three) by the same side (so as to allow certain unilateral force reductions to be accommodated within the scheme), some (say, one) might even be selected by chance (as a guarantee to the rest of the world that this disarmament scheme is a serious undertaking, not one that could be rigged by the two Superpowers acting in effective cooperation - not that I believe that such worries make any real sense, but apparently they do make some political sense in some quarters). And the process would be repeated each year, after each Superpower has satisfied itself about compliance by the other and about the fact that its own security is not in jeopardy.

The idea is, that such a disarmament scheme, together with the rules that characterize it, should be agreed by one round of negotiations; then the process would bring about disarmament (very gradually, of course) through an agreed sequence of unilateral steps (like chess moves), without requiring any additional intergovernmental talks. These unilateral decisions would determine what would actually be reduced; their nature and sequence is devised so as to make effectively disadvantageous any "unfair" behaviour.

The reader might doubt about the validity of the last assertion (and with reason, since the description of the disarmament plan has been here extremely terse); but he may easily imagine variations, or additional specifications, of the scheme I have outlined, that might take care of his own objections. The main point I want to make is, that one can envisage a procedure, perhaps a bit complicated, that would provide a workable disarmament scheme. Note that no intergovernmental negotiations are envisaged on the specific identification of what should be eliminated (there would of course be instead a lot of infragovernmental talks!); and the rules of the game, agreed upon in the intergovernmental negotiations, would be completely symmetrical, even though they would of course result in asymmetrical reductions, corresponding to the real world asymmetries in strategic deployments.

10. The disarmament process we have sketched should be preceeded by a freeze of strategic weapons; indeed a freeze agreement is always considered an essential precondition for any consideration of disarmament. Yet even a freeze is hard to achieve by negotiations, because of the difficulty to define precisely the scope of strategic forces (not to mention the question of qualitative improvements).

How to cope with such a difficulty in the framework of the novel approach we have proposed? I am not sure I can offer any convincing suggestion; presumably the matter should be settled by a broad, but not too detailed, committment. I must however emphasize that, in the framework of the approach I have just outlined, this problem is considerably less serious than in the traditional context. Indeed one might even envisage the possibility to have an agreement of the type outlined above, that ignores altogether the freeze problem. Would such a disarmament treaty, without any formal committment not to deploy new weapons, make any sense? I submit it would, to the extent that in the agreed disarmament scheme the weapons to be eliminated by one side are selected, at least in part, by unilateral decisions of the other side. For in such a case it would become rather difficult to push through the decision making system of each Superpower the decision to deploy new weapons, with the prospect that they be immediately selected by the other side for elimination in the framework of the disarmament scheme.

11. The outline of a possible disarmament procedure has been presented so tersely here that I certainly could not hope to have convinced anybody of its merits (if any); at best I may have inspired sufficient curiosity to motivate some readers to look up the original reference[3]. Indeed the main point I wish to make here is not to advertise a specific scheme, but rather to suggest a complete change of focus in arms control negotiations: the goal to negotiate the specific terms of an arms control agreement should be altogether

abandoned; instead the negotiation should aim at establishing an agreed procedure, consisting of a sequence of unilateral moves. This process should begin after the negotiation has been concluded; it would not involve any additional intergovernmental negotiations (although it might of course envisage consultative talks); it would last several years (say, a decade); and it would result in substantial, although very gradual, disarmament.

12. The approach followed up to now at SALT has been a step-by-step process; a deal involving some limitation, followed immediately by a novel negotiation aimed at establishing the specific terms of the next agreement. I have already emphasized how impractical this procedure is; because of this, an enormous amount of political committment had to be expanded, to push through and to defend each deal. But an even worse feature of this approach - one that I mentioned at the beginning, but that I would like to reemphasize now - is the fact that such a situation, through the "bargaining chip" mechanism, acts effectively as a stimulant to the arms race: for those who push for novel weapon developments can argue that "we need them to strengthen our bargaining position"; while those who oppose such developments are accused of "undercutting the position of our negotiators". Such claims and accusations carry a tremendous political weight. Time and again we have seen this mechanism at work in the US decision making process (even the advent of the cruise missile is largely due to it); no doubt an analogous mechanism is also operative in the Soviet Union.

As we noted at the beginning, this effect is so important to put into question the very usefulness of trying to restrain the strategic arms race by negotiated agreements. The way out I suggest is, rather than giving up altogether the hope of achieving disarmament by negotiations - which I am afraid would be tantamount to giving up altogether the hope to attain any significant measure of arms control - to try instead and achieve a disarmament plan extending over many years (and involving no additional intergovernmental negotiations throughout its unfolding). And I submit that by the approach I advocate such a goal may be feasible.

A disarmament plan reached at SALT and extending over several years would moreover reconcile the need to proceed gradually, with the urgency of signifying to the rest of the world a substantial committment by the two Superpowers to move cooperatively in the direction of disarmament. Only this might provide an adequate basis for tackling effectively other threatening world problems such as nuclear proliferation.

13. One objection to the approach to arms control that I have outlined is its unorthodox character. Yet the idea to change the focus of a difficult negotiation from the aim to agree on the substance and details of the matter to the setting up of an agreed procedure that shall then yield "automatically" (i.e., without any additional negotiation) the substance of the agreement, is not so outlandish. For instance, it is used in labour disputes, and just in the most difficult cases, when no agreement can be reached by direct negotiation on the substance of, say, a novel contract. It is then often found convenient to try instead and agree on a procedure, that will eventually yield the new contract (that both sides agree a priori to accept); usually this procedure involves some mechanism of

arbitration (that may even be quite complicated, consisting of several "moves" to be effected sequentially by the various parties involved). And these systems do work in real life.

The change of focus in the negotiation that I advocate constitutes indeed a major novelty; the type of agreement that I envisage contains features that are undoubtedly hard to accept (notably the committment to a certain measure of disarmament, to be undertaken without knowing precisely which items will be affected by it). But this approach does bypass the difficulties that I identified above; and it allows to institute a far reaching yet gradual disarmament process, thereby preserving not only the essence of security, but also its perception.

Something that appears unusual when first proposed, becomes more and more familiar as people think and debate about it. Thus the validity of a proposal should be discussed on its objective merits, and faults, rather than on its orthodoxy,(I might again mention in this connection the "daylight saving time" idea as a pertinent example: when first proposed, it certainly appeared as a bizarre contraption, not to be taken seriously; eventually this idea was recognized to yield real advantages; now it is adopted routinely).

14. Another type of opposition to the approach I advocate must be anticipated; it is motivated by the fact that such a method might indeed work.Thus those who are opposed to arms control and disarmament - and who would have much less leverage if the approach I advocate were adopted - will certainly react very bitterly against any suggestion to proceed along these lines. But because I believe (perhaps wrongly) that the arguments supporting this proposal are sound, I expect this opposition to manifest itself by a refusal to discuss the merits of the novel approach, rather than by specific criticisms of its logic.

As I noted above, the prevalent stand of those who are opposed to arms control and disarmament is not to state this position openly, but rather to posture as champions of arms control and disarmament; provided the terms are fair. Then they find out that the terms are never quite fair enough. Indeed many of them have succeeded in convincing themselves by their own arguments so effectively, that they genuinely consider themselves to be the only hard-headed supporters of arms control and disarmament.

With the approach I advocate, their stand would be rather more difficult to take; to the extent it is a bluff, it would be exposed; to the extent it corresponds to a genuine self-delusion, it would force them to question their own motivations.

15. I have argued that the approach I advocate would be more conducive to substantial arms control and disarmament; it would make the setting up of a far reaching disarmament scheme feasible, and politically acceptable; it would minimize the risk that the negotiating process itself be exploited to justify open-ended qualitative and quantitative weapons expansion.

But are my arguments sound? Could they be tested?

One kind of test shall of course be provided by the objections that will be forthcoming in the debate that I hope to stimulate with this paper.

Another type of test could be attempted by a simulation experiment. Two parallel games might be set up, simulating, say, SALT. In the first one, the goal would be to negotiate an agreement of the traditional type, in which what is to be limited and eliminated is precisely spelled out in the text of the accord. In the second one, two phases should be envisaged: first a negotiation aimed at establishing an agreed procedure consisting of a set of unilateral interlocked moves for assessing and identifying what should be limited or reduced (also how, and when); then the carrying out of this procedure. The second phase would involve no interparty negotiations, but perhaps a lot of infraparty talks; since of course for the simulation to be significant the different interests acting within each decision making system should be represented, so as to mimic the interplay between international and infragovernmental talks, that, as I have argued - and most people would certainly agree on this - are crucial to any understanding of the negotiating process.

A comparison of the outcomes of these two simulation games would be interesting, provided such exercises were conducted in a fashion likely to resemble the real world.

The second type of game would also be useful as an educational exercise: it would force every participant to appraise "fairly" the "value" of the various components of the strategic arsenals (one's own and that of the other side), since any biased assessment (be it motivated by "worst case analysis", by ideological prejudice or whatever) would put the side entertaining it at a disadvantage.

16. A new spiral of the strategic arms race between the Superpowers is upon us, with the advent of that most destabilizing weapon, the cruise missile, and with the impending deployment of a new generation of strategic weapons (Trident, B1, Marvs,etc.; and their Soviet counterparts). Moreover, some of these weapons (notably the cruise missile, and the so-called mininukes) tend to draw into the strategic arms race also other countries besides the Superpowers.

The record of past and present attempts to negotiate arms control and disarmament agreements suggests that, without rather drastic changes, this trend cannot be checked, much less reversed.

But this course leads to catastrophies.

It is thus necessary to think of new approaches to arms control and disarmament. I have tried; no doubt others could do much better. The new leadership in the United States might now be receptive to such suggestions. Answering to a question put to him by the Arms Control Association, presidential candidate Carter wrote: "Whether next year it would be best, if there is still no agreement, to seek to implement the Vladivostok ceilings and go on from there to agreements on reductions and technological controls, or whether a new approach would be required is a judgement on negotiating policy that I would make only after careful review of where the talks stand in January, 1977" (emphasis added). The leadership in the Soviet Union continues to appear committed to detente and is outspoken supporting the attempts to check and reverse the arms race. Maybe the time is ripe for a breakthrough. But such progress is not likely to be achieved by the traditional approach.

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27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

I. Malecki (Poland) XXVII-8

POSSIBILITIES AND RANGE OF PROHIBITION OF NEW TYPES OF WEAPONS

1. The present state

The year 1976 saw a number of important facts in the field of disarmament. A prominent place should be given to the proposal of the Soviet Union, concerning the prohibition of new types of weapons of mass destruction, twice discussed by the Committee on Disarmament. It is closely connected with the agreement concerning the prohibition of weapons destroying the human environment.

For many years Pugwash has been initiating agreements to limit the use of various new types and systems of weapons, to quote but Pugwash projects concerning the prohibition of biological or chemical weapons. Therefore, general proposals concerning the limitation of usage of new weapons, of any kind whatsoever, should earn special attention of Pugwash and come under discussion. This is all the more justified because the matter is in its initial stage and many controversial points have been raised - these were reflected in the discussion in the Committee on Disarmament. Pugwash proposals, concerning ways to overcome arising difficulties, should be very useful in further discussions. Therefore, in the present paper I shall deal not so much with the idea of the prohibition of new weapons, which is universally supported, but with specific problems which emerge in the process of formulating the prohibition in question.

2. Future - oriented actions

The fundamental question, philosophical in its character, is whether one should ban something one knows nothing about; this was the main objection raised by opponents of the agreement in the Committee on Disarmament. There are a number of reasons for concluding an agreement on the prohibition of new weapons of mass destruction.

1. On an average, 7 years elapse between a scientific discovery and its full practical implementation. When introducing new weapons this period may be slightly shorter; however, it is rarely shorter than 5 years.

This means that in a scientific policy one has to have a certain margin of time at one's disposal. Accordingly, it is not to be wondered that many laboratories working for military needs concentrate on new weapons. It is, therefore, important to intervene in this early phase of a new weapon development.

2. A general framework is necessary into which one could easily fit agreements concerning specific parameters of individual weapons. The agreement on the prohibition

of new weapons would provide such a framework for future fragmentary agreements concerning specific types of weapons.

3. Even in the already concluded agreements there are certain gaps, particularly in the interface between the ranges of individual agreements, e.g. between the agreement on the prohibition of biological weapons and the agreement on the protection of the environment. The general agreement should fill in these gaps and, to some degree, systematize the functioning of the individual agreements.

Let it be remembered that we are discussing here weapons of mass destruction, not merely all new weapons. The question is, whether the traditional definition of a weapon of mass destruction may be applied in full to new weapons. This matter is also worth discussing in Pugwash. It seems that some doubts have been generated by including among weapons of mass destruction certain actions which produce lasting effects, though of local character in the initial phase.

3. Features of new weapons

The point of departure in the negotiations of the agreement is the definition of which weapon should be considered "new". It seems that we should not limit ourselves to entirely new weapons, for instance those based on physical phenomena unknown at present, because the probability of their development is small compared with the probability of the development of weapons resulting from essential improvement and enlargement of action of weapons based on phenomena already worked out in the laboratories. Once this is taken into account it becomes easier to classify new weapons according to the following aspects:

a) principles (modes) of action of weapons,

b) targets attacked,

c) character of action of weapons,

d) defensive-offensive system.

a) With regard to types of action, new weapons may be divided into three groups: direct action, i.e. delivering the missile to the target area; action through a beam of elementary particles; action of wave radiation.

At present almost all the weapons belong to the first group but it is known that the possibility of using weapons of the second the third group is being investigated.

b) Chief targets of attack in wars have of old been human beings and products of human labour (buildings, cultivated fields etc.). "Barren land" tactics means complete destruction of the biosphere in a given area. New weapons may offer possibilities of creating disturbances in the troposphere and ionosphere and also destructive subterranean actions (e.g. contamination of subterranean waters, artificial earthquakes).

c) Until World War I weapons used were of almost exclusively physical action type, destroying attacked targets mechanically and thermally. The use of poison gases opened the way to chemical action against live organisms, i.e. to using chemical weapons. In the last 20 years biological weapons emerged, acting chiefly through bacterial contamination of human beings and animals. Unfortunately, these weapons do not exhaust all the possibilities; more complex action against human organisms may evolve, namely action on genes and the psyche.

The second way consists in destructive actions by means of physico-chemical processes, for instance destroying the surroundings by burning.

d) Contemporary war is based on complex operations; accordingly new ways of combining various kinds of weapons, i.e. creating new systems, belong to the category in question. The development of air-space aircraft and low-flying missiles may serve as an example.

4. Weapons using wave radiation (wave weapons)

Among new weapons it is this group that should be given special attention, insofar as future agreement is considered, because weapons of this kind:

a) have never been used before, though there are theoretical possibilities of using them;

b) are in a class of their own, clearly distinct from other kinds of weapons;

c) would necessitate exhaustive research in order to overcome the below-mentioned difficulties.

"Rays of death" are still in the realm of fantasy, though they might become reality even in the near future - this is precisely what the new agreement on the prohibition of new weapons should prevent.

As far as the technological aspect of the matter is concerned the realization of a wave weapon amounts to obtaining a sufficient concentration of energy at the spot where the target is situated; by using scanning one may destroy large areas. The achieving of the effect depends on four factors: the character of radiation, the power of the source, the concentration of the beam of radiation, and the attenuation of the waves by the medium.

The character of radiation depends on the frequency and the energy carrier; in practice we have at our disposal ample possibilities of selecting the most dangerous radiation, particularly as regards coherent radiation (laser). The power of the source is the critical point here; however, by means of improving effectiveness of radiation and using impulse radiation, an enormous power of several thousands kilowatts may be produced.

The concentration of the beam of radiation is the next difficult problem because in existing systems it means, that the dimensions of the source should be large in relation to the wavelength. Meeting this requirement is aimed at in many research projects and was partly achieved in lasers.

The attenuation of waves is a quantity dependent on the kind of medium and on the frequency; for instance, the use of supersonic waves is ruled out, as they are strongly damped in the air.

The main targets of wave weapons will most probably be live organisms, above all human beings. The most dangerous here is the action of ultrasonic waves and hard electromagnetic radiation. The effects may be lasting (burns, blood coagulation) or temporary (physical and mental impairment). We cannot exclude, however, the possibility of destructive actions against inanimate targets; such possibilities exist in the case of the action of infrasonic waves or of a beam of coherent light.

Physico-chemical action is possible, too, consisting in, for instance, disturbing the state of ionization of circumterrestrial strata.

It is evident from this brief review how ample, unfortunately, are the possibilities for the development of new weapons. Scientists will bear part of the responsibility for the realization of these possibilities; however, at the same time they may contribute to the limitation of new forms of the arms race.

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W. Mendl (UK) XXVII-9

REDUCING DISTRUST AND TENSIONS BETWEEN NATIONS THROUGH DEFENSIVE STRATEGIES

My starting point is the almost universal acceptance of the right of every state to security from military attack, intervention, or pressure. Since the end of the last century efforts to provide for the security of nations and at the same time to promote international peace have followed two closely related paths, which it was hoped would lead to universal disarmament and the establishment of international institutions for the preservation of peace. In spite of the persistence and devotion of many in pursuit of these goals, the results have been rather meagre, although there have been some real successes, particularly in the field of arms control. Is there, then, another approach, not necessarily supplanting but reinforcing the traditional approaches to ensuring both national security and international peace?

I suggest that such an approach exists and would involve reformulating the question "What do we need to ensure our security?" to read: "How can we provide for our security in ways which do not threaten the security of other states?". To think in such terms would be to link the concept of national defence to the concept of international security.

There have, of course, been many attempts to deal with this problem through international disarmament negotiations. One so far insoluble issue has been the attempt to distinguish between offensive and defensive weapons. The dilemma has been neatly summarized in the allegory of an imaginary disarmament conference among the animals, in which "The lion wanted to eliminate all weapons but claws and jaws, the eagle all but talons and beaks, the bear all but an embracing hug".[1] The problem of devising a purely defensive strategy seems to be equally intractable. For instance, should such a strategy include the inability to bomb an aggressor's bases on his own or other states' territory?

These dilemmas point to the fact that there is no symmetry in the security needs of states. An effective national defence must take into account a country's geographical position, the size and resources of its neighbours, its own resources and population, and what are perceived to be its essential national interests. Thus, as a purely hypothetical example, Brazil might insist that it requires a fairly large air force to protect and reinforce outlying and almost inaccessible provinces. Guiana might require a much smaller force for the same purpose, but how could it be sure that Brazilian air power would not also be used to threaten its security? Multilateral negotiations have so far not succeeded in resolving the fundamental difficulty of how to ensure that unequal though legitimate requirements for defence do not threaten the security of other states. What agreements have been

made have usually been short-lived.[2] Is it then possible for unilateral initiatives to overcome this problem?

There are at least three types of initiative which, if applied more widely, might assist us towards this end.

1. Perhaps the most 'painless' and also the most superficial approach would be a declaration of no first use of certain types of weapon. This has usually been associated with nuclear weapons and is a policy favoured by China. There is no reason why it might not be applied to bombers, tanks, and other conventional weapons. It can be argued that such declarations would not be any more convincing than the declaration that a nuclear test explosion was only for the peaceful use of atomic energy. Nonetheless, it may have a useful and possibly significant psychological effect for two reasons:
   a) It might help to reduce tensions which are directly attributable to armaments. After all, this is an important motive behind SALT - the attempt to reassure one another that one is not going to launch a pre-emptive strike.
   b) By creating a moral climate which must be taken into account if a government wants to change its mind. It would then have to assess the impact of such a decision not only on public opinion at home but on the reactions of other governments and world opinion.

2. A more far-reaching and 'revolutionary' approach would involve the adoption of quite specific policies. They might include the decision not to possess 'offensive' weapons; not to export such weapons; not to export any arms to certain areas (e.g. countries engaged in a conflict or likely to be so engaged, countries under UN sanctions). As another example, a law might be promulgated forbidding the dispatch of armed forces outside the national territory.

   All these are in fact policies of the Japanese government. They stem from the peculiar circumstances of Japan's postwar constitution and its hold over important sections of public opinion.[3] It may be argued that Japan's low key defence policy is due to the protection of the United States and to the international environment in North-East Asia, and that things might change very rapidly if American protection were withdrawn and the Japanese developed an acute perception of threat from one of their neighbours. Nevertheless, it is true that today one of the world's richest and potentially one of the most powerful states is not seen as posing an immediate military threat to anyone.

   Yet it is also true that such policies run into the same difficulties as those already mentioned when it comes to defining 'offensive' weapons. Indeed, in this respect there exists some ambiguity as far as Japanese policy is concerned.[4] Moreover, it

can be argued that the policies outlined above may be more appropriate to island nations than to landlocked countries surrounded by more powerful neighbours.

3. So far I have only considered the problem of how to reassure the neighbouring states. What can be done to deter them from aggression without undermining this reassurance?

The most 'revolutionary' development would be if states adopted the strategy of territorial defence.[5] The security policies of countries such as Sweden, Switzerland, and Yugoslavia are good examples of the implications of this strategy. It involves a variety of means which might include conventional armed forces, a citizen militia, and methods of non-violent resistance. It could be based on a mixture of frontal defence and defence in depth, including forms of guerrilla warfare. There are real difficulties in finding the right mix for each country. Obviously, reliance on an armed citizenry would be more effective in a nation that is homogeneous and where there is a large measure of agreement over social and political institutions and procedures, than in a society riven by ethnic, social, or political antagonisms. In some cases the effectiveness might also depend on the prospect of eventual assistance from outside. Non-violent methods of conducting conflict have often failed in the past, though there have been some outstanding successes, such as the Gandhian movement in India and, in a more limited sense, the protection of the Jews in Denmark under the Nazi occupation.

Territorial defence, which is perhaps the purest form of a defensive strategy, has the great advantage of combining deterrence (i.e. making the cost of attack and occupation unacceptable to an aggressor) with a defence organization which does not threaten the security of other countries.

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This brief listing of various models of <u>defensive</u> strategies still leaves unresolved the problem of applying such policies to the superpowers and the other great states of the world. Their sheer size and the weight of their resources make them appear as a threat to the security of other countries, whether that is their intention or not. The <u>defensive</u> policies of such states might correspond to some of the features which have characterized Chinese policy hitherto. China's nuclear policy has been based on the principle of no first use. It has an immense military organization but a limited capacity to project its military power for any distance beyond its borders. It has adopted the concept of people's war with the object of drowning an invader in the sea of its armed masses. Whilst this has been very largely China's military strategy over the past thirty years, this is not to say that it will remain so. Indeed, there may be changes, especially if the military assume a dominant position in the country, for China, too, has its military-industrial complex.

Nevertheless, the Chinese model might repay careful study as an indication of how very large and populous countries might emphasize their defensive rather than offensive capabilities.

If the world's powerful states were to shift their attention to formulating security policies which would seem less threatening to other countries, such a development would probably lead to the dismantling of present alliance systems, for American and Russian troops would return to their national territories. Such moves could have the paradoxical effect of heightening the sense of insecurity felt by some members of the Atlantic and Warsaw Pacts. This might be dispelled if all the states of Europe concentrated their efforts on deterrence through territorial defence. Even so, they might feel exposed to occupation by more powerful neighbours who would claim to protect them against real or imagined threats. One way of dealing with this problem would be through an international agreement that no state should move its troops into another's territory without the sanction of the United Nations. This would not have been an acceptable solution in the 1950s when the United States commanded an automatic majority in the Organization. No such claim could be made today for either of the superpowers or any other country.

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I have deliberately stressed many of the difficulties and complexities involved in the formulation of security policies which are designed to protect the state and reassure other states. Nor have I by any means touched on all the problems. For instance, there is the question of the protection of legitimate interests outside the national territory (on the high seas for example); the question of how to deal with aggressive ideological and economic policies which are barriers to the development of mutual trust; the question of how to curb the mometum of gigantic military-technological-industrial complexes which, on both sides, provide so much of the dynamism of the strategic arms race between the superpowers; and so on. Above all, there is the brute fact of the asymmetry of national security problems.

Nevertheless, some real benefits may be derived from pressing for the adoption of genuinely defensive security policies. They would have to vary from country to country, but they might be based on various combinations of territorial defence and the kind of constitutional and legal constraints which operate in Japan. There would be at least three advantages in such a reorientation of defence policies:

1. The measures would avoid the charge of hopeless idealism which is always levelled at proposals for unilateral disarmament, and they would circumvent the business of always waiting for the other side to show its good faith before one does anything oneself, which has been the curse of international disarmament conferences. Indeed, they might have the effect of creating that climate of trust which is necessary for successful disarmament negotiations, and they might even provide an incentive which would make

governments take the whole business of disarmament more seriously than they do.

2. If a defensive defence were adopted, it would be that much easier to call a government's bluff when it proposed to take military measures 'in the interests of national security'. It is notorious that all governments insist that their intentions are purely defensive and that their public almost invariably believes them, for in this field it is generally assumed that the government knows best. A deliberately defined defensive policy would provide a yardstick with which to measure a government's intentions and to insist that defence policy meets the criterion of being unprovocative.

3. Finally, such measures would also provide scientists and technologists with a yardstick whereby to assess whether the work they are being asked to do for national defence meets the criteria of a national policy designed to ensure national and international security.

References

1. Madariaga's fable quoted in Quincy Wright, A Study of War; Vol. II (Chicago, University of Chicago Press, 1942), p. 806, Note 122.

2. The contrast between the wide-spread acceptance of the need for disarmament and the small and largely ephemeral successes which have been achieved in this field is discussed by Inis L. Claude in Swords into Plowshares: The Problems and Progress of International Organization (New York, Random House, Third Edition, 1964), pp. 267-72.

3. Wolf Mendl, "Die japanische Verfassung und Japans Sicherheitspolitik" (Beiträge zur Konfliktforschung, No .3, 1976, pp. 69-90).

4. Ibid, p. 84. Japan's acquisition of the Phantom (F-4EJ) is a case in point. Its role is that of interceptor, but its in-flight refuelling capability and its potential as a bomber would make its conversion to an offensive role a relatively simple task.

5. Territorial defence and methods of non-violent resistance are the subjects of a growing and impressive literature. Two books in particular offer a critical but sympathetic examination of the many aspects of these approaches. One is a symposium edited by Adam Roberts, The Strategy of Civilian Defence: Non-violent Resistance to Aggression (London, Faber, 1967); the other is a monograph by the same author, Nations in Arms: The Theory and Practice of Territorial Defence (London, Chatto & Windus for The International Institute for Strategic Studies, 1976). It is noteworthy that at the Geneva Disarmament Conference in 1933, the United States proposed the renunciation of the use of force, except for territorial defence. Wright, A Study of War; Vol. II, p. 806, Note 122.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

G. von Bonsdorff (Finland) XXVII-10

REDUCING DISTRUST AND TENSIONS BETWEEN NATIONS

A. Ideological starting-point

The problem of reducing distrust and tensions between nations and systems has grown more important than ever before, because many observers are convinced that there is a real possibility of suicide and annihilation of mankind within the subsequent 50 years. This eventuality can be prevented only in an atmosphere of mutual trust and far-reaching co-operation.

It is a central task of the Pugwash Movement to contribute to the creation of the intellectual basis for trust and co-operation. Some results have already been achieved, but much more remains to be done. I shall concentrate myself on the unsolved problems.

One of them is the lack of a sufficiently strong common ideological platform among scientists in the whole world. It could be possible to strengthen our intellectual unity and solidarity by a new appraisal and analysis of some generally accepted concepts.

Thus, I am sure that we all are ready to declare ourself as supporters of peace, democracy and humanism. This is without doubt very good, but it is not enough in the prevailing situation. Therefore, it could be useful to reformulate these concepts and transform them into positive peace, international democracy and ecological humanism.

Peace is, generally speaking, absence of war. A state in the world community which could be characterized as an interval between wars - as the period between the first and second world war - has by the peace research experts been called negative peace. In contrast to that, positive peace signifies a permanent state, when war is impossible, or at least very unlikely to be used as a method for solving disputes between nations. Conflict has in this case been replaced by peaceful change. Striving for influence has been replaced by co-operation. In the context of co-operation it is necessary to take into consideration the interest of the partner, not to force the partner to comply with one's own interest.

Democracy is realization of equality between actors in a system. International democracy means equality between states, irrespective of their size and population numbers. The basis of equality cannot be possession of economic and military resources, because that will forfify unequality, but the recognition of the many-sided dependence between the actors, interdependence. The increase of the number of sovereign states during the last fifty years from about 50 to about 150 can be regarded as a factor effectively promoting international democracy. Another factor working in the same direction is the growth of so-called transnational actors on different levels, governmental and non-governmental international and regional organizations and agencies. The decision-making method of international democracy is consensus between the actors, not unrestricted majority rule. This method has already to a certain extent been put into practice within the frame of the European Security Conference.

Humanism is recognition of the individual and his basic rights as the primary object for political activity. Ecological humanism means a state in the society, when not only the inequality between human individuals has been abolished, but when there also has been established a sort of equilibrium between human community and nature. This could be regarded the same as harmony between all basic forces in society, such as minerals, plants, animals and human beings. The achievement of a harmony of that kind seems in the long run to be a condition for the future existence of the human community.

B. Factors influencing the change of the community

A common ideological platform seems to be necessary for the final, or at least stable, solution of basic problems connected with the creation and growth of a universal world system. On the other hand, the transition process towards the new system has been initiated even if this platform is not worked out in all details. As a matter of fact, the process has started already with the foundation of the League of Nations after the first world war, even if no regular and uninterrupted evolution can be observed. This process has, however, to a very large extent accelerated during the 1960's and 1970's. It is now quite possible to believe that a new world system could be realized about the year 2000 or in the first decades of the next century. This may depend on the evolution of certain elements of the system, which could be divided in different groups, among others the following:

1. Common interests. The central common interest for mankind is the elimination of the risk of a nuclear war, which probably would mean defeat for all participants. In this respect the year 1962 could be regarded as a

preliminary turning point, as the outcome of the Cuban crisis clearly demonstrated that the military strongest powers in the world are not ready to accept war as an alternative method for political activity, when peaceful methods do not seem to answer the purpose intended. After 1962 has followed a period characterized by détente and partial progress in the field of arms control, but the world is as yet far from a new security system with built-in guarantees for a stable world peace.

2. Common goals. A very conspicuous common goal of mankind is the exploration of the space surrounding the earth. The travel of Jury Gagarin into space in 1961 was the first time in history when our whole planet was put into relationship to forces outside this planet. The exploration of space has hitherto been mainly conducted by Soviet and American scientists, but they are in a higher degree representatives of the whole mankind than of their own countries. It is, therefore, of essential importance that American-Soviet co-operation for the space programme has been initiated during the 1970's, and it should be continued in agreement with the corresponding organ of the United Nations.

3. Common development. The most far-reaching characteristic of the global development process is probably the beginning of the transition from industrial to postindustrial society in an increasing number of regions. Many of the new problems arising in this connection are very similar in different countries, irrespective of their economic and social systems. One of those problems could be described as the necessity of saving mankind from becoming a slave to technology. Global planning must be considered in this and many other fields. Examples are the energy problem which was brought to the fore by the oil crisis in 1973, and question of initiating a new and more just economic order in the world.

4. Common development. The common resources of all peoples in the world which are discussed in the prevailing situation are situated on the sea-bed beyond the limits of national sovereignty. These resources have solemnly been declared by the United Nations as the "common heritage of mankind". It is of central importance that the common heritage should be administered and used in the interests of the whole human community, which obviously means that the primary aim is to diminish with their help the gap between development stages in different regions of the world.

5. Common institutions. The central symbolizing, debating and co-ordinating common institution of mankind is the United Nations Organization which

has, in practice, become universal after the entrance of the People's Republic of China and both German states during the 1970's. Among the U.N. activities the peace-keeping forces represent a new ideological attitude to the use of militarily organized units: not for waging war, but for preventing others from waging war. Thus, from a universal point of view military units have been given an acceptable task for the first time in history.

6. Common dangers. The origin of the current common dangers for mankind is above all the severe aggravation of food, population and environmental problems. There have been many phenomena of the same kind in earlier stages of history, but after the second world war they acquired quite new dimensions. Now the problems have grown so large, that their existence can be regarded as a potential threat to the whole future of mankind. But, on the other hand, there has emerged a new sense of global responsibility for the solution of these problems. This is the background of the rising number of world conferences and agencies investigating remedies or at least useful measures.

7. Common territory. As a result of the evolution of air traffic in the last decades it is now possible to move in a few hours to every other place on the earth. That means that physical distances in the traditional sense between states and nations have ceased to exist. All peoples are more or less in the position of neighbours, and it is therefore necessary for them to modernize and renew their forms of mutual contact.

It seems likely that all the seven groups of elements here mentioned and perhaps also other similar questions will more and more influence the transformation of the international system during the coming decades. As a consequence of the new situation it seems necessary to proceed in the international community from a decision system, based on power, influence and majority rule to a decision system based on interdependence, co-operation and consensus.

C. The tasks of Pugwash

It would be an important task for Pugwash to discuss and analyse the evolution of the international system. This can in the first hand be done in different conferences and special symposia. It is also possible for Pugwash to adopt certain general principles and recommendations. The principles could be presented to the public opinion and the recommendations also to governments in various countries. In addition to that I would find it useful to appoint a study group composed of scientists from different nations with the task of studying the changing process of the international system.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

A. Levai (Hungary)

XXVII-11

WHERE LIES THE REAL DANGER OF NUCLEAR POWER?

1. One of the most important tasks of Pugwash is - to my mind - to inform the public objectively and with intellectual honesty on the challenges facing humanity. This belongs to the finest academic tradition. This has occurred in relation to the problem of nuclear power at the 26th Pugwash Conference at Mühlhausen, and it is well reflected in the section on "Nuclear power and nuclear weapons" of the Statement from the Council. Nevertheless, due to the fact that the public concern about nuclear power has sharply increased in recent times and that in several countries this problem became an important political issue, I believe that a restatement of the attitude of Pugwash might be desirable, extending beyond nuclear weapons to other questions connected with the "danger" of nuclear power.

Firstly, it should be stated that nuclear energy is not the only challenge against humanity. Serious accidents in some chemical works in Italy, USA and elsewhere recently endangered thousands of inhabitants, and it is only a question of time when chemical and bacteriological processes and weapons based on them might result in similar fatal effects as the misuse of nuclear power. From this point of view it is essential to know where lies the real danger of nuclear power? Does nuclear power - as it is used today and will be used in the next decades almost exclusively for the generation of electricity - really endanger the health, safety and welfare of human beings?

2. Public objection to nuclear power has several targets, under the main headings: "plant safety", "environmental aspects" and "physical security of reprocessing (plutonium)". As regards plant safety, it may be stated once more that a nuclear reactor can never explode like an atomic bomb; accidents of this type are excluded both theoretically and practically. However, under quite special circumstances, ordinary chemical reactions could occur that might damage the reactor core. But the effect of such chemical reactions would remain inside the plant, due to a series of physical barriers that inhibit or prevent the release of fission products from the fission processus taking place in a nuclear reactor. Accidents of this type have rarely occurred - although not in commercially operated plants - without significant release of fission products. They can be expected to happen in the future, too. Failure of equipment and human errors may occur in any complex technical system, like wis

acts of sabotage or enemy fires against the plant are possible. But, due to the very serious "defence in depth" of nuclear power plants and other nuclear installations, the public risk from these stations is less than from conventional power plants.

Thus, the principal public risk from nuclear power does not come from accidents but from the unavoidable, continual low-level radiation on one hand (see section 4) and, on the other hand, from the risk of diversion or theft of nuclear fuel, especially of plutonium, for terrorist actions (section 9). Some details of these two features, the environmental impacts and the safeguard will be discussed here and, while admitting the vital importance of environmental aspects, I want first of all to emphasize that, in my opinion, it is the second of these features which predominates.

3. Without doubt, the steady and rapid increase of the world's energy consumption in the next decades cannot be met by conventional energy sources (coal, hydrocarbons and hydro-power) alone. The growth of population, the rise of per capita consumption, productivity, waste production and the use of throwaway products are going on; efforts to reduce energy consumption are scarce and - although very necessary - cannot stop for a longer period the total growth of energy consumption. Unconventional energy sources, such as geothermal or wind power, are under development, but they will never have an important part in total energy production; fusion and solar power represent huge capacities but, nowadays, they are neither technologically nor economically sufficiently developed to be capable of contributing significantly to energy production in the near future (in this century). Therefore, all state- or private-managed organizations responsible for the availability of energy, and many scientists agree that nuclear energy based on fission of nuclei cannot be replaced in the coming decades. Almost all countries (including some oil-producers) make provisions for a more or less significant use of nuclear fuel in the production of electricity in the near future, its share in total production reaching 50% or more in 2000. We must face nuclear energy whether we like it or not. I believe the emphasis must be on the prevention of dangers due to radioactivity, or the theft of materials suitable for bombs, instead of exaggerating these questions and holding back a sufficient supply of rationally used energy.

4. As to the dangers: from the point of view of environmental impact, the main source of radioactivity in the nuclear system is the nuclear itself, in which - due to the fission of uranium nuclei - some of the fission products are highly radioactive. (For comparison: a nuclear reactor of 1000 MWe capacity is during its

lifetime a potential radiation source of about 2000 Megacuries, equal to 2000 tons of radium.) But this immense radioactive source is properly retained in the hermetically-sealed fuel elements inside the reactor and, after having been used and removed from the reactor, it is placed in storage tanks until the spent fuel will be chemically reprocessed to recover valuable plutonium and uranium (see section 5). No doubt small quantities of highly radioactive fission products can sometimes escape from the fuel cladding into the reactor coolant where they are collected as liquid or gaseous wastes. Most of the radioactive fission products have, however, very short lifetimes, decay rapidly to innocuous species, and do not constitute any hazard to the general public. Nevertheless, a small part presents important radiation emissions with a considerable half-life (e.g. cobalt-60 5 years, krypton-85 10 years, strontium-90 28 years, caesium-137 30 years, carbon-14 5770 years, etc.). High-level radioactive wastes are handled in the nuclear power plant and removed as solids of very small volume and shipped in special containers to licensed disposal areas (section 6). Low-level liquid wastes are stored for some time (1 to 3 years) permitting most of the radioactivity to decay, then diluted to harmless levels and discharged. (It may be mentioned here that domestic tapwater has generally more than twice the radioactive level of the waste discharge of a typical nuclear power plant, milk, or alcohols, e.g. whisky 100-times as much, salad-oil about 500-times, etc.). Gaseous radioactive wastes - escaping very rarely from the fuel - are also removed from the coolant system and retained mostly in charcoal-trapping systems until they decay; small amounts are discharged into the atmosphere in accordance with existing regulations. These regulations do foresee e.g. in the USA that the increased exposure of persons living in the direct neighbourhood of a nuclear plant must be less than 1% of the natural background exposure. In practice, this limit has never been reached. (For comparison: sulfur dioxide emitted from a coal-fired power plant has about 30,000-50,000 times the public health impact of the krypton-85 and xenon-133 emissions of an equivalent nuclear plant. This so-called relative hazard index reaches for the nitrogen oxides from an oil-fired power plant the value of about 4500.)

5. As stated above, the bulk of radioactivity (nearly 99%) generated due to the fission in the nuclear reactor remains as solid waste in the very carefully sealed and protected fuel elements until they enter the fuel reprocessing plant. Shipping of the spent (partly burnt) fuel elements from the power plant to the reprocessing factory is carried out in heavily shielded, high-integrity casks. Reprocessing itself will, for fuel- and financial-economy reasons, be necessary to recover valuable plutonium and uranium; for the time being the first consideration predominates; nevertheless, the process is not generally used. In the

reprocessing plants the fuel elements will be chopped, then dissolved in strong acid, the uranium, plutonium and fission product wastes chemically separated. Although the fission products will be here concentrated in small volumes for disposal, understandingly the erection and exploitation of such reprocessing and waste disposal plants constitutes one of the major objections against nuclear energy in public concern. As compared to a coal-fired power plant of 1000 MWe capacity where about 1,000,000 tons of ashes are produced annually, the volume of high-activity solid wastes from an equivalent nuclear plant is very small (about 10 tons) but, of this, at least 10% is highly radioactive, containing partly long-lived elements (strontium, caesium, plutonium, etc.).

6. Nuclear wastes must be disposed in such a way as to ensure that they are isolated from human environment for a very long time (several thousands of years). Till now, only very few reprocessing plants are operating throughout the world, mainly for military wastes. Experience gained from such plants shows that the storage problem can be solved with present knowledge in several steps:

- First, the highly radioactive liquid waste solutions are temporarily stored at the plants in large, double-walled, stainless steel, underground tanks for up to five years. (Some of the earlier, single-walled, carbon steel tanks from the military programme leaked in the USA in 35 years and some radioactivity escaped into the ground, a fact which contributed much to the controversy over nuclear wastes);
- After this period the solutions will be converted to stable solid form and incorporated into either glass-base or cement materials impervious to ground water for very long time. These solid - probably stainless-steel covered - blocks will be shipped to the long-term interim storage repository within another 5 years (by that time, the radioactivity will be reduced to less than 0,05%). Recent investigations in the USA suggest neglecting this step so that final disposal comes immediately after the first step;
- The solidified nuclear wastes from the second storage will be permanently disposed of by burial in rock salt (or granite or anhydrite) formations that have not been disrupted by earthquakes for millions of years and have been free of circulating water. It is also possible to eliminate radioactivity from the solid wastes by transmutation through burnup in nuclear reactors to non, or short-lived, radioactive materials, a technology which must yet be proved. No final decision has been reached as to how the waste will be handled definitely, but it is not so urgent at present.

Anyway, the problem of handling and storing radioactive wastes as now planned for the nuclear power industry makes the confinement and control of such waste in

all steps a relatively simple technical problem. Besides, the last step of definitive storage is not pressing; on the contrary, it may be useful to have the solid wastes at any time retrievable to additional processing to extract valuable components. (It is very unfortunate that, in some places, even the prospection of suitable geological formations for the deposits was prohibited, thus preventing the storage of radioactive wastes from hospitals, laboratories, etc. At the same time, it is remarkable that, in the USA alone, 10 million tons of chemical and biological wastes were produced and disposed of in 1970 by means not always under adequate control; one of the reasons of great public concern against radioactive wastes.) Independent of this, as a matter of policy, it must be first decided whether the possible hazards from the recycle process are offset by the benefits of the added energy it would make available for electricity generation. To my mind, fuel economy considerations will be decisive in the future.

7. The third main problem, the public fear of plutonium will now be reviewed. Because of the confusing relationship between nuclear fuels and nuclear weapons on one hand, and the expected transition from today's low-enrichment, thermal-type reactors to plutonium-producing breeders in the future on the other hand, there exists considerable public concern about the possible diversion of plutonium for the purpose of manufacturing clandestine nuclear weapons. This public fear transcends often both the benefits and the low-level environmental risks of nuclear energy.

8. The public has been told: "plutonium is the most toxic substance known to man." Independent of the fact that, from the point of view of chemical toxicity in ordinary sense, there existsquite a lot of chemical substances thousand or million times more toxic than plutonium. It is a toxic substance indeed and can be hazardous if large enough amounts were allowed to be deposited in the body. As a strong and long-lived alpha-emitter (half-life of plutonium 239 is about 24,000 years), it is heavily radiotoxic and very damaging when in direct contact with living tissue; inside the human body it is highly carcinogenic, but relatively innocuous when outside the body. The most important route of entering the body is inhalation. In the past, almost all plutonium injected into the atmosphere originated from weapon production and weapon test explosions prior to 1975. It is noted that the total activity of plutonium processed for military purposes amounts to 15 mission Curies, of which the amount released into the atmosphere through test explosions and deposited on the surface as fallout could be half a million Curies. The plutonium-radioactivity inhaled per person in the USA

in the peak year (1963) is estimated to be as high as 0,012 Nanocuries; the plutonium consumed in diet and water is about 1/6 of this amount. (It is estimated that 1 millionth Curie inhaled per person could induce 1% incidence of lung cancer; this means that the probability of a 1% increase in lung cancer due to weapon-test explosions-born plutonium is one in hundred thousand. The fallout from these explosions were distributed worldwide, and the fact that no increase of lung cancer due to military test-explosions could be observed in the past - although nearly 6 tons of plutonium had been released into the atmosphere - does not mean that no causality exists. At most, it was not proven; the increase might be too small to show up in the medical statistics.)

In the nuclear energy industry plutonium can regularly escape only during reprocessing of the spent fuel (section 5) and manufacture of new, plutonium-mixed fuel elements; in extreme cases it may occur in a serious reactor accident. As stated above, fuel reprocessing is not widely used yet but, in any case, the amount of plutonium (which is an inevitable by-product of the fission-type nuclear fuel cycle) to be handled till 2000 is of the order of magnitude of what has been required till now for weapons production. The release of plutonium from the nuclear power industry during reprocessing is, according to experiences gained so far, about one thousandth of Curie per 1000 MWe-plant per year, an amount which may be reduced by current capabilities by a factor of 100, and in the future by another factor of 1000 or more. (Calculating the total capacity of nuclear power plants estimated for the year 2000, and referring to the release of plutonium from military test-explosions we get a reduction factor of a million-million.) Catastrophic reactor accidents - highly improbable events - might have releases up to 50 millicuries per 1000 MWe-plant per year (i.e. a ten-thousand-millionth part of the military release referred to above).

Concluding: it is true that 1 kg of plutonium is potentially capable of delivering several millions of lethal doses of lung-cancer inducing radiation (as a comparison: the amount of arsenic imported annually into the USA is enough to cause more than a thousand million of death) but, on the one hand, plutonium is highly controllable and, on the other hand, only a very small fraction of any uncontrolled plutonium could conceivably get into human lungs. The dispersal of plutonium could have a potential terrorist threat value, but obtaining the material would be difficult; equally toxic and biological poisons are more readily available. The delayed effect of plutonium (long-term toxicity) compared with the immediate effect of some chemical poisons (e.g. nerve gas) could make it uninteresting for diversion purposes through dispersal. Plutonium as toxic substance should, nevertheless, not be discounted as a hazard to the public.

9. Another and, to my mind, most important question is the real hazard which lies in the use of plutonium as prime material of nuclear weapons and its potential diversion for uncontrolled and unlawful uses. The rapid growth in number and capacity of nuclear reactors will result in the generation of increasing quantities of plutonium. In the USA alone, the projected amount of fissile plutonium expected to be recovered from nuclear power plants will rise from about 4000 kg in 1975 to 37,000 kg in 1985. Plutonium recovered in the rest of the world might be of the same order of magnitude. Eight to 10 kg of such plutonium are needed to make an atomic bomb if knowledge, skill and special hardware are available. (It may be mentioned that the amount of plutonium processed so far for military operations is estimated at more than 200,000 kg.)

Plutonium contained in irradiated fuel inside or outside the reactor is inaccessible to diversion due to the extremely high radioactivity (section 4). The theoretical possibility of such a diversion exists only during spent-fuel reprocessing where plutonium occurs at some points of the process in relatively pure form (section 5), and during shipping this material for new fuel fabrication if necessary. (In the new, plutonium-mixed fuel elements the content of plutonium is only 2 to 3%, the remainder being uranium. That is why the extraction of plutonium is very expensive, complicated and easy to control.)

Moreover, there are very strict and well sophisticated regulations for the safety and safeguard of plutonium during shipping, fuel reprocessing and manufacturing, rendering them more rigorous from time to time. But it must be admitted that there is no way one can make misadventure truly totally impossible. It is assumed that there are today at least 14 nations in the possession of fuel reprocessing technology, and any of these nations is a potential constructor of nuclear bombs. In the future, small, highly developed countries or large countries on the way to development could make their own bomb-material in reactors fuelled with natural or slightly enriched uranium. With sufficient plutonium gained in them, the construction of a bomb is difficult but not impossible for a nation that wanted to do so. It would be, on the other hand, quite expensive and difficult to keep secret, which precludes almost totally the possibility of producing plutonium for subnational or dissident groups without being detected.

10. The prevention of the proliferation of nuclear weapons among sovereign nations is conceded to be a problem of diplomacy and not only of safeguards. The latter is directed primarily towards limiting access of subnational groups to the technology and materials. The safeguard system of the IAEA may be not perfect, it gives at present only a restricted guarantee and must be strengthened

continuously. The act of non-proliferation must become universal and absolutely strict guarantees should be constructed so that the export of nuclear materials, equipment and technology will not be a channel spreading nuclear weapons. Some network for worldwide guarantees must be found, which does not prevent any nation using nuclear energy for peaceful purposes, without discrimination, but which would erect a strong barrier against any spread of nuclear weapons, accepting in this sense a very accentuated discrimination. This exists today as well.

It is, to my mind, false to say that, if we have nuclear plants, radioactivity will destroy human environment and culture. Nuclear energy might be a peaceful instrument of human beings, but it is wise to claim at the same time that safety design be elaborated to reduce risks to an acceptable level. It is understandable that people everywhere are demanding more information and greater participation in decision-making processes. Alas, there is no denying, the possibility of infernal devastation is also included in nuclear energy. This must be prevented with the concentration of all forces over the world. To create a world climate for non-proliferation and thus reduce the understandable anxiety of non-nuclear nations is a task worthy of Pugwash.

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J.D. Frank (USA) XXVII-12

SOME PSYCHOLOGICAL ASPECTS OF THE PROLIFERATION OF NUCLEAR POWER

Among the many unprecedented dangers created by the splitting of the atom, a rapidly increasing one is posed by the spread of nuclear power plants without adequate safeguards, especially with respect to reprocessing spent fuel. Since other participants will be considering psychological features of other aspects of the nuclear age, this presentation will be concerned solely with this problem.

The relevance of a psychological approach lies in the fact that all the relevant decisions, such as whether to buy or sell nuclear power plants and with what safeguards, are determined by national leaders, operating as individuals and in small groups. Ideally, their decisions should be based on strictly rational analyses of the objective facts. Since data on which these and other political decisions are based, however, are always incomplete, value-laden and subject to many sources of error, other psychological processes inevitably play a big part. A major consideration is that "objective facts" are partly determined by the observer's values and perceptions. These filter and distort incoming information, strengthening confirming input and minimizing information that would threaten the observer's values. Behavior is determined by psychological reality, and this is only

partly determined by objective reality. Furthermore, the more incomplete and equivocal the data, the greater the part played by subjective filters, such as motivation, stereotypes, world-view and the like.

Certain important psychological factors contributing to difficulties in controlling nuclear proliferation are the following. National leaders, in general, are optimists--that is, they believe the course of action on which they have determined will succeed. For those who have reached positions of power, this state of mind is reinforced by the fact that their plans have succeeded more often than not or they would not be where they are. As a result, they typically tend to minimize difficulties of courses of action they favor. Moreover, the dangers of nuclear proliferation are not real psychologically because they are indefinite and distant in time. The only clear and present nuclear danger to the United States at this time, for example, is presented by the arsenal of the Soviet Union. Other nuclear nations are either allies or have too few weapons to pose a threat. Politicans, whose lives have been spent dealing with immediate problems, characteristically let more distant problems wait until they become pressing. The distant threat posed by nuclear proliferation does not compete adequately for their attention.

The fundamental psychological problem, I believe, is that the incentive structure underlying spread of nuclear power plants without adequate safeguards is heavily weighted toward further expansion and against adequate controls.

Incentives can be simply conceptualized as the desired or undesired consequences of behavior. A person's perception of the consequences of his actions determines whether or not the act will be carried out. The more powerful the consequences, the

more certain their occurrence and the closer in time they are to the act, the greater their effect on behavior. How the consequences are perceived, and therefore their influence on behavior, depends on their psychological reality, which may differ from their objective nature. Thus a small but certain immediate reward usually has more effect on behavior than a much stronger but remote and uncertain punishment. Persons who cannot stop smoking, for example, continue to do so because for them the immediate and certain pleasure of a few puffs on a cigarette outweighs the uncertain danger of cancer or heart disease years hence.

A calculation of the positive and negative consequences of promoting or regulating the spread of nuclear technology according to these principles unfortunately yields an overwhelming balance in favor of promotion.

From the standpoint of the supplier of nuclear energy, promotion serves the admirable end of helping the economic development of energy-poor countries. By so doing, it enhances the supplier's influence over the recipients and strengthens its bargaining power in international negotiations. At the same time, it contributes billions to the balance of payments and provides profits for industry. These benefits are large, tangible and immediate.

The immediate consequences of insistence on safeguards, on the other hand, are almost entirely negative. Their installation slows up the process of transfer of nuclear energy and increases the cost, thereby weakening the supplier's competitive position with respect to its rivals. Requirements for procedural safeguards, moreover, restrict a negotiator's ability to promise nuclear energy in return for political or other concessions, as President Nixon did with Israel and Egypt.

From the standpoint of the recipient, the calculus of immediage gains and losses reveals a similar imbalance. Avoidance of safeguards permits more rapid acquisition of badly needed energy sources and keeps open the option of diverting nuclear material to the manufacture of weapons, which would greatly enhance a nation's power and prestige with respect to its non-nuclear neighbors.

Acceptance of safeguards hampers the attainment of these ends and implies the surrender of some degree of national autonomy and of the prestige that accompanies self-sufficiency. The expense of developing their own nuclear capability may, to be sure, induce some potential recipients to accept these disadvantages, but the desire to acquire as much energy as possible in the shortest time will induce many to plunge ahead, especially when they find suppliers who cooperate with them for the sake of immediate gain.

The long-term consequences of failure to control the spread of nuclear power are potentially devastating for both suppliers and recipients. One such consequence is the danger of nuclear accidents--a relatively minor concern since devastation caused by the explosion of a nuclear power plant would be localized, like that of a volcanic eruption. Much more serious is the production of quantities of plutonium oxide, the most deadly man-made poison, fatal in doses of millionths of a gram, which retains it lethality for thousands of years. No matter how tight the inspection and stringent the safeguards surrounding nuclear reactors, a small percentage of plutonium oxide will escape. Over time, this is certain to accumulate to levels that will become a serious menace.

This danger, however, pales in comparison with that created by the use of plutonium to manufacture nuclear weapons. This is the main concern of the suppliers because it erodes their power position based on their monopoly of these weapons. Moreover, as countries with widely different, often inimical, political systems and values gain a nuclear capability, international tension will rise, which, in itself, increases the danger of nuclear war by accident or misjudgment. To this danger must be added the increasing likelihood that terrorists or criminal elements will gain possession of nuclear weapons to be used for blackmail or actual destruction. For the recipients, who at this time are primarily interested in acquiring power and prestige rather than holding on to what they have, these delayed consequences carry less weight but they are equally pertinent.

Considered solely in terms of the calculus of objective benefits and dangers then, it seems apparent that nuclear power is more of a menace than a boon to humankind. Its maximum possible benefit is some rise in the living standards of energy-poor nations and a partial and temporary alleviation of the energy shortage in the industrialized ones. These improvements may perhaps be reflected in some increase in international stability, although this will probably be more than counterbalanced by the destabilizing effects of the spread of reactors. The maximum potential harm of nuclear power, on the other hand, is, literally, the extermination of the human race. Why, then, is it so hard to maintain adequate controls over the spread of nuclear reactors? The explanation lies, I believe, in the psychological unreality of the dangers created by the absence of safeguards, not only because of their remoteness and uncertainty, but because they have no base in experience. Humans have incredibly sensitive equipment for detecting light, sound, odors

and objects touching the skin, but none for detecting radiation. Moreover, except for the inhabitants of Hiroshima and Nagasaki and the handful of people who have seen test explosions, no one has experienced a nuclear explosion. Hence it is little wonder that the dangers of nuclear proliferation, while recognized intellectually, have so little effect on behavior of national leaders.

Difficult as the psychological obstacles to halting proliferation of nuclear power plants are, I believe that the calculus of incentives can be modified through effective leadership. Leaders have considerable inherent power to influence the behavior and perceptions of their followers, by virtue of the fact that obedience to legitimate leaders is essential for the creation and maintenance of all stable societies. The leader's chief means of influence is superior access to the mass media. This influence has been greatly enhanced by the advent of television and radio, which have a much greater impact than the printed page. The leader can mold public opinion particularly effectively concerning those areas in which imponderables, as opposed to clear and obvious facts, play a large part; and this is certainly the situation with respect to proliferation of nuclear power plants. Thus leadership, skillfully exercised, could do much to shift the balance of incentives from nuclear proliferation to nuclear restraint. This would facilitate the eventual total elimination of nuclear energy as substitutes become available, which is the only ultimate solution.

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THE MEDITERRANEAN IN CONTEMPORARY POLITICS

The international political scene is in constant flux, producing rapid changes both in the regional and in the global disposition of political forces. The rapid transformations occurring in the world community today require continuous efforts to identify the characteristics of the new relations, the subjects of political action and the potential trends of future developments.

This may explain the increased interest in the Mediterranean of practitioners as well as analysts of political affairs and may also account for the diversity of views on this important geo-political area. Whereas, until recently, the Mediterranean was primarily regarded as the region of confrontation of interest between two major powers, the present situation offers a greatly different picture, supplemented by important new elements, relevant not only to the European region but also to world affairs on a much broader scale.

In considering the current peculiarities of political developments in the Mediterranean, as well as the different rates of these developments, the first need is to identify the main determinants of the new trends and of the numerous new factors which, on their part, constantly provoke new classifications.

The economic and the strategic importance of the Mediterranean is above all the result of its specific position. It is the juncture of three Continents; it is situated in the immediate vicinity of the Soviet Union and of some other socialist countries; rich oil deposits are not far away. To this should be added that it is precisely the Middle East oil which is the main source of supply for Western Europe and Japan today, and that the United States is also expected to need more and more Middle East

oil in the future. This geographic area is, further, the junction of numerous telecommunication lines and airways, in addition to containing traditionally important sea routes. Despite all innovations, Gibraltar, the Bosporus and the Dardanelles, and the Suez Canal retain their economic, political and military weight.

The Mediterranean, the region surrounding the Mediterranean Sea, constitutes the natural boundary of 17 states. It accommodates over 300 million people belonging to different races, traditions and cultures. Furthermore, these states are at a different level of social and economic development; they follow different lines in their foreign policies and alliances, and their internal systems are also diverse.

This diversity of objective situation is combined with a host of outstanding territorial disputes, relics of colonialism in economic and cultural relations, of the activities of sundry imperialist and neocolonialist forces. For years, all of this has been causing periodical conflict in this part of the world. This is particularly true of the Middle East conflict, which has lingered in the annals of the post-war years as a permanent and apparently unresolvable regional dispute, inevitably bearing, to a greater or lesser extent, on the overall political situation.

If we add to this the unsettled Cyprus issue, the deterioration of Greek-Turkish relations, the civil war in Lebanon, and the Algerian-Moroccan dispute over Western Sahara, an impressive list is obtained of the more permanent conflicts, apart from the numerous lesser issues that arise occasionally.

During the past years, the Mediterranean has been the object of particular concern of the great powers, who compete with each other in establishing new relationships in this important point of the globe. The

southern flank of NATO ends on the shores of the Mediterranean; CENTO is active in the east; France is endeavouring to practice a certain measure of independent policy; there has been increasing interest on the part of the EEC in recent years; and, last but not least, the presence of China should also not be overlooked.

After the end of World War II, nearly all the Mediterranean zone was within the French and the British spheres of influence. Later on, as the position of these two former great powers weakened, the stage was taken over by the United States of America, who gradually fortified its position in the area, by political, economic and military expedients. Constantly adding to its strategic, political and economic assets in the Mediterranean, America built up a solid basis for its foreign political action, assigning the Mediterranean a vital part in its global strategy.

Regarded from the vantage point of today, all this tends to emphasize the significance of the Mediterranean, especially in view of the closeness of the neuralgic area of the Middle East, which, regardless of certain slow trends towards a settlement, manages to head the list of long-term international disputes. In view of all this, it is natural that the vagaries of the military and political balance of power, alignments and realignments, or the efforts to maintain, at least in broad terms, global equilibrium between the super-powers should be all reflected on political developments in the Mediterranean.

Due to a set of circumstances, a lasting settlement of the Middle East issue is not yet in sight. This, in turn, leads increasing importance to the Mediterranean, which is, in a way, becoming more and more associated with this critical spot in world politics. It has been, namely, found that each intensification of the Middle East conflict in the

past only served to intensify the interest in the Mediterranean, which was reflected in very obvious efforts to fortify military and political positions in the countries of that region.

This growing tendency to link the Mediterranean with the Middle East has added a new dimension to the Mediterranean space, making it the scene of military and political competition between the super-powers. Demonstrations of military presence, constant expansion of naval forces, the cruising of submarines equipped with nuclear missiles, and the endeavours not to lag behind the opponent's military strenght: all of this has turned the waters of the Mediterranean into a big stage for a show of military and naval might. At the same time, a close watch is being kept from the shore over this very significant feature of new relations, especially by some countries.

Of course, we should not forget that the changed state of affairs in that traditionally important and restless part of the European and world political scene was the outcome of a whole series of new socio-economic, military and technological factors. In the first place, the sweeping socio-economic changes on a world scale had an impact on this area too, either as a consequence of direct action of progressive forces or as a reaction to these actions. Thus, for example, the overthrow of the monarchy in Egypt and the ensuing changes had the direct effect of intensifying fears for the fate of oil supplies and deposits, which were then protected by military means. The subsequent changes in the Arab world, too, had a similar effect, since they were always regarded within the context of oil, that is, of the danger that its supply to the West might be reduced or cut altogether.

Regardless of the varied character of socio-political transformations which some Mediterranean countries have undergone and are still undergoing, it can be already claimed that all the post-war political developments had been reflected on this part of the world. The process of decolonialization, organized national liberation struggle, and changes of a social character produced the upsurge of a strong drive for national sovereignty, national integrity, and for non-interference from outside. Considering the price some of the Mediterranean countries paid for their freedom, it is not surprising that such a strong self-awareness could have developed relatively soon, helping these countries to attain political maturity and a deep insight into the totality of international problems.

It would be wrong, of course, to look for a common Mediterranean denominator, since this area accommodates a variety of states, who could be classified into quite different, often opposing, groups according to various criteria. Besides the capitalist states there are also socialist countries, as well as states following a line of socialist development. Along with traditionally highly developed political systems, there are countries who are only now evolving their political organization. It would be also extremely difficult to draw any parallls in terms of economic level, or with regard to cultural tradition or scientific and technological development.

Nevertheless, it seems to us that, during the past years, a sense of "Mediterranean identity" has been growing, implying both physical belonging to a certain geographic area and an insight in o the global realities of modern World and the desire to safeguard a peaceful and stable development of all the nations inhabiting the Mediterranean shores. Although this common denominator may not be yet sufficiently asserted and

may be differently interpreted in different places, which is only understandable, it is still a fact that the Mediterranean is increasingly regarded as a certain entity, and this tendency is likely to become even stronger. Despite the controversies as to the actual boundaries of the Mediterranean, it seems to us that the mentioned processes are occurring at a constant, though different, rate, as a result of the powerful socio-economic changes that are taking place, in this basin as well as in the world at large.

Due to changes in military technology, the presence of one fleet - the American one - was soon augmented by the presence of another naval force, and the ships of the two most powerful states began to patrol the Mediterranean, performing their various military-political missions. The traditionally powerful American Mediterranean fleet, with a dense network of bases extending from the eastern to the westernmost end of the Mediterranean coast, was faced with the fact of a growing Soviet fleet, which took advantage of socio-economic changes to obtain certain facilities in some Arab countries. The advances in the field of communications, supplies and manoeuvering ability made up, at least partly, for the difference in actual availability of bases. Thus, in military terms, too, the balance of power on the Mediterranean waters became a major component of the general global relationship between the United States of America and the Soviet Union.

These constant features, which are being increasingly associated with the Middle East and with the totality of relations in that area, have become so strong with time that no oscillations between the big powers and the individual countries from that area are likely to change the overall situation. Furthermore, regardless of endeavours, with more or less success,

to pursue independent national foreign policies, the general trends in the Middle East are based on the support of the super-powers to such an extent that effective foreign policies could be hardly imagined without their physical presence, and some countries could not even ensure their existence without it.

Due to all this, military presence in the Mediterranean, accompanied by constant declarations of support, represents a very important indicator of relations between the super-powers and various countries from that area but has strong implications for a much larger region. We should regard in this light the question of the validity and durability of various alliances in this part of the world, which are of a diverse character and whose strength and durability have been put to hard tests on some occasions. NATO strategists sometimes stress, not without reason, that a certain erosion of the military system had set in precisely in the Mediterranean, and that this component may have played a role in the broader visions of President de Gaulle. On the other hand, Albania was likewise the first member to leave the military-political alliance of the European socialist countries. A detailed analysis could discern a Mediterranean implication in this event too.

NATO's military-political analyses, even those published, have been raising for years the question of the real value of the so-called southern flank, comprising Greece and Turkey, whose relations are traditionally tense. Moreover, judging by past experience, there is hardly any alliance between these countries in the sense of co-ordinated military-political action. Although these two countries possess the same socio-political system as well as the same foreign policy goals, and although they are firmly associated with the leading NATO member country and her

abundant aid, the southern flank still remains an example of the precarious relations among the allies. The withdrawal of Greece from the military part of NATO and the maintenance of American military bases on her territory do not alter to any important degree the total picture, neither does this have any substantial effect on the ties among the NATO countries.

The attempts to liquidate the independent state of Cyprus, which opted for a road of free and non-aligned development, could also be regarded in this context as the wish to make use of internal instability in order to strengthen NATO's positions and to link it more firmly with the Middle East. In addition, the division of the unified and non-aligned Cyprus would not only provide another military base but would serve as a political stronghold for direct control over communications with the Middle East and over the relations between Greece and Turkey. However, apart from this "local aspect", such activities clearly show that a number of countries from that region can always expect obstacles to their independent political affiliations unless they observe certain rules of conduct, which the imperialist forces want to impose.

It goes without saying that such an attempt at solving the Cyprus question inevitably made the Greek-Turkish relations even more hostile and diminished their value to NATO, speaking in purely military terms. However, since it is sometimes difficult to predict the final outcome of trade-offs in politics, it is still impossible to discern the real cause of the tragedy suffered by Cypriots and the actual long-term objective that was being pursued. One thing is certain, though: in the present-day disposition of relations and forces, of main political agents and their actions, the efforts to preserve NATO are not slackening. Consequently, all the measures to fortify some vulnerable spots in this alliance can be

still regarded as part of the normal and customary practice of the leader of the bloc and of the forces which support her in this.

In addition to these purely military-political aspects, which are a reflection of NATO's strategy, in recent years the Mediterranean has tended to become the scene of ferments of another kind. It is not only that, in result of global political trends, the character and grouping of political forces has been changed, but the former chief strongholds of the western world are now appearing in a new light. There is a steady upward trend in the growth of progressive socialist forces, with different programmes and affiliations.

This is why a "red tide" is being now spoken of in the West, spreading fast and allegedly threatening to cause new political upheavals. Not understanding the need and the inevitability of change, some Western analysts persist in looking on these trends exclusively in a bloc context; they are convinced that the renunciation of one bloc automatically leads to affiliation to the other side, and that therefore all political realignments in the West inevitably strengthen the political positions of the East.

The events in Portugal were no doubt the best indication of the intensity and scope of these new tendencies, but also of the long and complex road that has to be traversed.

Because of the proximity of Spain, where change is also in the offing, developments in Portugal were followed with special attention and have a special significance. Subjected to a long period of terror, and subsequently racked between gradual economic-technocratic relaxation and attempts to modernize the forms of the country's political development, post-Franco Spain also represents a link in the chain of change in the Mediterranean. Due to its specific historical development, a powerful army,

and probably also because of the lesson of Portugal, the process of change will probably follow a different line. Still, it is already obvious that a certain shift is imminent in Spain's position within the make-up of forces in the Mediterranean. Closely tied to the United States by a bilateral treaty, Spain is thus indirectly linked with NATO, and American submarines with nuclear weapons and American military aircraft have found ideal shelter in Spanish ports and bases. However, regardless of the heightened interest on the part of America and some other domestic and foreign forces, all this has a completely different meaning today. The united forces of opposition to fascist dictatorship are constantly growing in strength; the members of this large common front, comprising a broad spectrum of ideology, from catholics to communists, are becoming more and more convinced of the need to introduce democratic reforms.

Let us add to this short review of current or pending developments on the Iberian Peninsula that in France and Italy there exist strong socialist forces, above all those within the Communist Party. Since the present trend is to create a common platform with other progressive forces, this is also an element likely to affect the overall political developments in the Mediterranean. If we compare the place of the political left in these countries today and in the past, it is evident that there is a steady advancement, which cannot be ignored, especially in a broader European context. The forces whose political programmes provide for socialist reforms of the society are today recognized even by their adversaries, who have to accept the realities of political life.

The fact that the Mediterranean coast also accommodates the People's Republic of Albania, whose foreign policies follow to a great extent the line of the People's Republic of China, that is to say, of an

Asian power, is yet another indication of the great complexity and diversity of the foreign policies practised by the individual Mediterranean countries as well as of the external forces trying to use this important region for their own end.

For some of these external forces, this region is an element in the total balance of their far-flung military resources and a means of demonstrating to the world that this ratio cannot be altered, with all the implications such activity entails. Of the People's Republic of China it could be also said that her presence in the Mediterranean possesses a far-reaching and global importance. For, although the Chinese fleet does not navigate the waters of the Mediterranean, Tirana has been a long time an important stronghold of political propaganda, from which China is trying to spread her ideas to Europe and the Middle East, persistently criticising the two super-powers and their attempts at "world hegemony". Being the only state which fully supports China's policies, Albania has a disproportionate importance for China, and this importance is becoming increasingly greater, particularly because of the complexity of political and social trends in the neighbouring Middle East.

In some recent theoretical analyses of developments in the Mediterranean, it is claimed that tension between the West and the East has been already eliminated in Europe, that the relations had become normalized with time, and are therefore no longer in the focus of attention of politicians and theorists alike. The boundaries have all been recognized by the states concerned, co-operation is being established along various lines, and the European scene is now endowed with another dimension: the relations between the North and the South, that is, between the developed

and the underdeveloped. Of course, when speaking of this division, the Mediterranean countries come to mind immediately, as most of them belong to the group of less developed European states and are thus plagued by serious problems in their relations with the industrialised world.

Some non-European observers, on the other hand, claim that there is not much commonness among the Mediterranean countries, with olive-growing perhaps their only common feature. This claim is supported by assertions that each of the states in question holds different political views, and that there is no possibility for a separate Mediterranean system of security. Naturally, the conclusion derived from this is that the presence of the two largest states, and of their fleets, is a fixed and almost immutable reality, despite possible reductions of their strength.

In trying to identify the elements which today link together the Mediterranean countries and peoples, one should doubtlessly proceed from much more substantial things than olive-growing. The Mediterranean region belongs as a whole to the less developed parts of Europe. With the exception of France, it is from this part of Europe that millions of workers are recruited to augment the work force of the industrialised countries of Western Europe. On the other side, in addition to being an area of labour migration, the Mediterranean is also a very important and attractive tourist region. Owing to its climate and places of cultural and historic interest, it attracts millions of visitors from other countries, particularly from Western Europe. The increased importance of crude oil has resulted in the rapid expansion of some industrial branches or in the construction of pipelines, which already intersect on many points the coast of the Mediterranean countries. The picture is made more complete when we consider that intensive efforts are currently made by all

Mediterranean countries, those from the European and those from the African Continents, to devise measure to prevent the pollution of the sea, which is a threat to the existence of the population of the region.

In its foreign policy, Yugoslavia has striven for years to convince the world that the Mediterranean should not be viewed separately from global world trends, but that it should be regarded within the context of general political developments, with all the attendant consequences. Yugoslavia has always lent its support to all initiatives to turn the Mediterranean into a sea of peace, to remove from its waters the competition of foreign fleets, and thus to reduce also the scope of their general confrontation.

All political initiatives serving to strengthen the ties among the Mediterranean states, regardless of whether they concerned the Mediterranean in a broader or in a narrower sense, have always met with Yugoslavia's approval. In supporting all the practical measures that foster in various forms this sense of common destiny and identity, Yugoslavia has taken an active part in all aspects of economic, cultural, scientific and sports co-operation, seeing in them an opportunity to gradually strengthen the contacts among the countries in question.

This is the light in which Yugoslavia regards her relations with her neighbours, notably those in the Balkans. Partly bordering on some Mediterranean countries, Yugoslavia is interested in fostering co-operation in all forms. She is permanently searching for new common grounds, in the spirit of peaceful active co-existence, regardless of differences in the socio-political and economic systems.

Yugoslavia's activities during the preparations for the European Conference on Security and Co-operation in Helsinki were aimed

particularly at bringing out the Mediterranean component, that is, to present the Mediterranean as an integral part of European processes, whose development may affect the general trends in Europe. This attitude was exemplified, among other things, in the effort to enable the non-European Mediterranean states to express their views and to help thereby the participants in the great dialogue to observe the problem in its totality. For, in the present age of rich and varied means of communication, it would be pointless to draw some artificial boundaries between parts that are increasingly tending to integrate. European security is inconceivable without normal relations in the Middle East, which only confirms the Yugoslav foreign policy concept of the indivisibility of peace or, as in this case, of security. On the other hand, the concept of intensive European co-operation cannot be put into effect along the East-West line alone, since precisely some countries from the Mediterranean region remain outside these groupings. Evidently, the solutions to some of the major problems in Europe (e.g. migration of workers, development of tourism, industrial co-operation) are quite inconceivable without the participation of the Mediterranean states. And, since economic interdependence is constantly increasing, the Mediterranean countries from the African Continent naturally exert more and more influence on European trends, and the strengthening of ties among the nations of Europe will logically impose the growing need to include also those Mediterranean countries in all forms of co-operation.

This concept of the new relations in Europe provides, in fact, the answer to the question of the feasibility of a separate system of Mediterranean security. Today, as we are waiting for the practical application of the Helsinki decisions, it is quite evident that there is

no need for a special system of this kind. The Final Act clearly stresses the significance of the Mediterranean. In specific terms, this implies that all progress in détente and in better understanding on European soil will be automatically transferred to the Mediterranean and to the Middle East. A secure Europe, filled with a spirit of co-operation, will inevitably affect the neighbouring regions - let us hope in a positive sense - by offering scope for yet closer integration of individual segments.

Faithful to her concept of international relations, as a socialist and non-aligned country, Yugoslavia firmly upholds the demand for a just settlement of the Cyprus issue and the restoration of all sovereign rights to the independent and non-aligned Republic of Cyprus, which, by its very existence, lessens the possibility and grounds for any confrontation on the Mediterranean. Yugoslavia also supports all efforts towards the settlement of the Middle East crisis.

Regardless of the different definitions of the Mediterranean region, which is at any rate beyond the scope of this paper, it may be claimed that it still remains politically heterogeneous, both with respect to forms of socio-political and economic orders, and to the foreign policy strategies practised by the Mediterranean states. However, their former only common feature: location on the Mediterranean Sea is today supplemented by a tide of processes that effect/ will substantial changes in the political make-up of individual states and of the region as a whole.

Burdened by traditional prejudices, unsettled international disputes and bloc machinations, the Mediterranean countries are nevertheless gradually entering a different stage of development, and it

is already evident that no region is exempt from the entire complex of international economic or political transformations. It depends, however, on the strength, ability and lines of action of various forces whether these changes will proceed peacefully and whether they will be understood as the internal affair of the peoples in question, or whether, on the contrary, other means will be applied, a contingency that would inevitably reflect on the overall complex of international relations.

It can be claimed, consequently, that the Mediterranean region is today the scene of momentous political processes, which are gaining impetus and arousing the notice of the big powers. Hence, the rate and main lines of future political trends in this important area will depend both on objective circumstances and on subjective forces. But, in spite of these incipient or merely intimated changes, it seems to us that, parallel to these, certain common forms will continue to grow; and, on the other hand, it may be precisely these changes which will bring out more clearly the common features of the Mediterranean as an entity.

For, if it may be said of international relations on the whole that they are marked by two extremes: co-operation and conflict, it seems that the present time is also marked by intensified efforts in the Mediterranean space to establish broader co-operation. The non-aligned countries from this region have been for many years the main proponents of measures which would turn the Mediterranean into a zone of peace and co-operation. The dismantling of foreign military bases, the withdrawal of the fleets of non-Mediterranean countries, and the adoption of forms of common political and economic activity of all Mediterranean countries would doubtlessly help to usher in positive

trends on a larger scale.

The non-aligned countries of the Mediterranean welcomed the provisions of the Final Act of Helsinki, convinced that the principles governing European relations would be extended also to the Mediterranean area. This should help, to quote the statement of the Yugoslav Foreign Secretary Miloš Minić at the Lima Conference, "the Mediterranean and other countries with vital interests in that region to devise ways of co-operation, leading to détente, and the reduction of armed forces and armaments in the interest of all".

The Fifth Non-Aligned Summit in Colombo also accorded special attention to Mediterranean problems, since the security in Europe, in the Mediterranean and in the Middle East are closely related, and new efforts are urgently needed to put into effect the decisions of Helsinki, among other things. To this end, the non-aligned countries are required, ~~int~~ in the political resolution, to intensify "their joint efforts in removing all obstacles which prevent the Mediterranean from being transformed into a zone of peace and co-operation, to the benefit of the countries concerned and in the interest of international peace and security".

The Conference on the implementation of the Helsinki decisions, to be held in Belgrade in 1977, will provide another opportunity for the non-aligned countries to continue their efforts and to expound their common views on the Mediterranean question, and to urge the introduction of peace and co-operation in that part of the world. And, in the present world of growing interdependence, stabilization of the Mediterranean situation would inevitably also imply stabilization in Europe.

The introduction of new relations, founded on equality, independence and non-interference in to the internal affairs of others, combined with measures to foster comprehensive and mutally beneficial co-operation, represents the only possibility of peaceful development in the Mediterranean. It is, at the same time, the answer as to what extent the Mediterranean could represent a socio-political, strategic or economic challenge to the world of today and to the strivings for détente. The Mediterranean countries and peoples are entitled to full and independent control over their destiny, constantly keeping in mind the lessons of the past and the possibilities offered by the present state of world affairs.

27th Pugwash Conference
Munich, Federal Republic of Germany, 24-29 August 1977

S. Mathias (Brazil) XXVII-14

DEVELOPMENT PROBLEMS OF THE ECONOMICALLY POOR NATIONS

In the hope of contributing to the discussion of the general problem of development of science in less developed countries, it is my intention to point out some aspects of this subject based on my own views, and on my experience as a member of the staff of the Chemistry Department of the University of Sao Paulo from 1939 to 1972.

It is probably true to say that science in Brazil began with the foundation of the University of Sao Paulo in 1934. For the first time in the history of the country a Faculty of Philosophy, Sciences and Letters was created. The schools that existed before were all of a vocational character, with no tradition of scientific research. With the exception of a few institutions where scientific research in the medical and biological fields was being carried out, no significant scientific activity in the basic fields of mathematics, physics and chemistry existed. To start the new Faculty of Philosophy, Sciences and Letters, the State Government of Sao Paulo invited a number of distinguished European scientists and scholars to establish and direct the new departments of the Faculty, which was in itself a miniature of a true university. Many of the European scholars remained in the country for the rest of their lives and were able to develop a school in their particular fields.

It was only after the Second World War that scientific interchange with many developed countries really became customary, with selected students going abroad and visiting professors coming in for different periods of time. During this period the assistance of the Rockefeller Foundation was fundamental in stimulating certain fields of science, like genetics, which developed fast and is still growing. During the sixties, the Ford Foundation played an important role in helping to develop chemical research and teaching in the University of Sao Paulo. Beginning around 1966, a number of programmes sponsored by the National Academy of Sciences (USA) and the Brazilian National Research Council, covering a variety of fields in science and technology, started to be put into practice and many of them are still under way. One of them refers to chemistry and has been very successful. After six years of operation (beginning in 1970)

the programme has resulted in the establishment of a number of research groups in important and modern fields of chemistry, such as electron scattering, ion cyclotron resonance, organic and inorganic synthesis, polymer chemistry and electro-analytical chemistry, and in the establishment of new groups in photo-chemistry, X-ray crystallography and biochemistry. These groups have already published over fifty papers in international journals, and seven more have been accepted for publication. Nineteen M.S. degrees and five Ph.Ds. have been awarded, and forty-one M.S. and eighteen Ph.D. candidates are enrolled at the present time.

The Organization of American States has sponsored a programme of scientific cooperation among Latin-american countries by offering fellowships for graduate work in a number of selected centres of research in Latin America.

I have mentioned only a few events, mainly the ones with which I have been familiar or connected with in some way. Apart from these international cooperation programmes, there have been a number of cases handled less formally, i.e., through a direct interchange involving one local and one foreign scientist, both interested in developing a new laboratory in an area of common interest. My experience in many of these cases has been most rewarding. In almost all the cases the results have been positive with varying degrees of success, ranging from the creation of a nucleus of contact in an advanced country to the permanent settlement of the invited scientist in our institutions.

So far, I have tried to show some of the positive features of international cooperation in science. Let us now look at some of the drawbacks. To carry out successfully many of these programmes, a great deal of effort to overcome obstacles, ranging from simple bureaucratic difficulties to problems related with the import of equipment and chemicals, was required. These are, however, relatively minor things when we try to analyze the situation from a broader view.

The first serious question to be put is: what are we going to do with the scientists that are being trained? The problem in Brazil is not yet very serious, though some signs already are evident of a lack of jobs for physicists. For the time being most of our Ph.Ds. can still find posts in new growing institutions within our universities or government research institutes. The most important market, the one concerned with the development of our own technology, simply does not exist and is not foreseen for the near future. Our industry, though very prosperous, is controlled by multinational firms which have no interest in establishing research and development laboratories in Brazil.

This is a very serious situation hindering our scientific and technological development and keeping the country in economic dependence. Every country has the right to become technologically independent and this is the only way for true development. Is there no other alternative than the transfer of technology from the developed countries?

The second serious drawback is the political situation of most of the undeveloped or less developed countries, such as Brazil. Science, like other branches of human endeavour, requires a free atmosphere to flourish. Unfortunately, such an atmosphere does not exist in the country, and this reflects on our universities, where the new generations of scientists are being trained. Since 1964, a disguised form of military dictatorship is ruling the country, remaining into power through the alleged pretext of fighting subversion. In order to justify their permanency, a "phantasmic monster" was created, a kind of monster no one believes in. Many eminent scientists were forced into "retirement", thus dismantling flourishing schools in different fields of science. The last blow happened in 1969 with the forced retirement of more than forty distinguished scientists and the suspension of their civil rights for ten years. Most of them live in exile inside, and some outside the country, where they hold prominent positions in outstanding universities all over the world.

Nobody doubts that the basis for development is education. And here comes the fundamental question of how the rich countries can help the poor ones. This is a very difficult problem, as education starts from the moment a person is born and continues all through his life. Not only large funds and continuity are required but especially highly qualified educators. Such programmes should be maintained, improved and enlarged, and they deserve the highest priority.

Finally, allow me to say a word about scientific cooperation. Men of science usually communicate easily, since they all speak the same language. To contribute towards the advancement of science, to stimulate scientific research, to act as a sort of federation of specialized scientific societies already in existence and stimulate the creation of new ones, the Brazilian Society for the Progress of Science was founded in 1948, and has today over 4,000 members. In 1973 the first steps were taken to join similar societies in the continent of America. The first meeting was held in Mexico City on 27 June 1973, during the Conference "Science and Man in the Americas" which was attended by representatives of the American Association for the Advancement of Science, "Consejo Nacional de Ciencia y Tecnologia (CONACYT) de México",

"Sociedade Brasileira para o Progresso da Ciencia", and similar bodies from Colombia and Peru. In the following years other societies joined in this effort and the first issue of the journal "Interciencia", published in three languages, appeared. This journal is sponsored by the "Associacion Interciencia" which was founded in 1974 for the purpose of linking the scientific community in the Americas.

There are, I believe, under different names, about 40 societies for the advancement of science in the world. Maybe it is about time to think of an international federation linking all these societies.

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F. Csaki (Hungary) XXVII-15

SOME PROBLEMS OF EUROPEAN SECURITY, DISARMAMENT AND COOPERATION

Previous Pugwash meetings often discussed the problem of security, co-operation and disarmament in Europe. The reason may be that Europe plays a special role in the security of the world. The density of conventional and nuclear weapons in this continent is the highest; two mighty military groups: the NATO and the Warsaw Pact forces are in direct contact and confrontation with each other.

Although great strides were made in the process of détente after the long era of the cold war, satisfactory relationships and cooperations between the two parts of Europe, with their different political, socio-economic and military systems, scarcely exist.

In the process of détente an important advance was the signing of the Helsinki Final Act by the leaders of thirty-five nations from Europe, Canada and USA.

The Helsinki Agreement

The Helsinki Final Act includes the following problems (called also "baskets"): 1. questions connected with security in Europe; 2. cooperation in the fields of economy, science, technology and environmental protection; 3. cooperation in the humanities and in other fields; 4. steps to be taken after the conference.

With regard to the first basket, some basic principles have appeared for the first time in a multilateral international document. These include the principle of the invulnerability of the boundaries, declaring that the participating states regard all the boundaries of each other and of all European states inviolable, so that from now on they will refrain from attacking them. It was also the first time that the rights of persons belonging to national minorities, and the obligations of the states toward them are formulated in a multilateral international document. The basic principle on human rights states clearly that the states must respect the rights of their citizens belonging to national minorities, ensure their equality before the law, and their full equality to assert their human rights and basic freedoms.

The first basket also deals with certain military questions, under the title of the so-called "confidence-building arrangements", but not in the framework of the

military problems since the latter were placed out of the scope of the Conference. Undoubtedly, there exists an interrelationship between the political and the military sides of security; inasmuch as the positive steps undertaken on one side affect favourably also the other side.

The atmosphere of détente was, for example, favourably influenced by the mutual and advance information on major military manoeuvres on the part of the participating states, especially if these are intended to take place near frontiers.

The second basket discussed the possibilities and forms of economic cooperation between the European states. A broad cooperation in the fields of trade, industry, science and technology, environmental protection, communication and transport was aimed at. The chapter on scientific-technological cooperation specified many fields, some old ones, like agriculture, power, physics, but also new areas, such as seismic studies, research in the problems of glaciology, life under conditions of perpetual frost, space research and so on. Cooperation in the field of environmental protection was also proposed.

The Helsinki Agreement proposed the extension of personal connections between scientists, the exchange of informations, as well as extension of trade information, marketing, standardization, development of business connections, unification of medical and other controls, and the settlement of trade disputes.

The third basked of the Helsinki Final Act deals with cultural, educational, informational problems and human relations. The general political introduction states that the cooperation in the cultural, humanitarian and other fields will be carried on on the basis of the principles of sovereignty, of non-interference in domestic affairs and the respect of the national legislations. The aim of cooperation in these fields is formulated in the introduction, as strengthening peace and understanding among nations, and the intellectual enrichment of the human personality.

After Helsinki and before Belgrade

One of the most interesting problems to be discussed at the Pugwash meeting in Munich is perhaps the present state of affairs concerning European security and cooperation, the developments since the signing of the Final Act in 1975, and the tasks ahead before the Belgrade Conference.

Generally speaking, we may state that considerable advances were made in the last two years towards the fulfilment of the expectations of the Helsinki Final Act. In some respects good results were obtained, in others perhaps more could be achieved. Frankly

speaking, however, some serious problems have also arisen which are worthy of discussion.

Immediately after the signing of the Helsinki Final Act, published opinions were expressed that the socialist countries have gained more from Helsinki than the free-market countries. Later on "Soviet military threats" were mentioned by some political leaders and generals. Recently, the problem of "dissidents" and "violation of human rights" in the socialist countries is being posed as the centre of a political campaign. These symptoms can hardly be evaluated otherwise than as efforts to halte détente, scale up the armament race, and throw dissention among states.

The fundamental question of international relationships is: are we able to make the processes of détente irreversible?

The most important steps are well known: the whole of the Soviet-American relations and their actual central element, the limitation of the strategic arms (SALT); further development of European security and cooperation between the countries, which accepted the closing document of Helsinki; and, not in the last resort, the disarmament deals and agreements, respectively, concerning various problems discussed by diplomats and experts in Geneva, Vienna and at the U.N. forum.

With regard to Belgrade, if we try to assess the period since Helsinki nearly two years ago, we shall approach the truth perhaps best by stating that the European conditions are characterized by the most essential political principles belonging to the so-called first basket of the closing document. The most important thing is undoubtedly that peace prevails on the continent.

Some circles, however, try to stop further development of European cooperation, and remake the achievements attained so far by referring to the protection of the spirit of détente and voicing the need of accounting for the implementation of the principles accepted in Helsinki. Some groups try to discredit the socialist systems in the eyes of the European public opinion.

The second basket contains the principles of economical and other cooperation. And although the results are in this respect rather considerable, the concentration of efforts against any further development is also apparent, e.g. the campaign to discredit the financial credibility of socialist states, which has been going on for months.

In addition, the campaign to present the "Eastern trade" as a source of political danger is carried on with at least the same intensity.

The Common Market keeps up limitations, which directly contradict the spirit of Helsinki. The proposals for the Common Market and CMEA to arrange their relationships, or for calling together all-European energy, or traffic consultations, on a level and with the intensity they deserve, have still not been met by deed. Only the organization of an environmental protection conference offers some hopes.

The extraordinarily rich contents of the third basket, concerning exchange and mutually useful flow of people, culture and various informations, were practically manipulated and deformed by certain quarters so much so that instead of the renaissance of contact, a falsified, truncated variant of the document may become the basis of slander, ideological and national insult, and, last but not least, organized political intervention.

The Helsinki document of European safety and cooperation calls for the multiple extension and development of the interstate relationships, and not to prescribe the norms of one or another social system as a preliminary condition for cooperation.

Disarmament : a commandment of our days

The common opinion of the analysis of international power relationships, the armament experts and the scientists playing a decisive role in the worldwide technological context, is that the elaboration of the disarmament measures must be given absolute priority at the negotiations between the socialist and free-market countries. Disarmament is a commandment of our days.

There has never been a more actual consultation on disarmament, to ensure the possibility of cooperation of every nation and government, than the Extraordinary General Assembly of the U.N. dealing with disarmament, promises to be.

The course of consultations on disarmament in Geneva and elsewhere, based on a defined agenda, may be influenced favourably by worldwide consultation to be held after this U.N. Extraordinary General Assembly with its purpose to advance - as it is to be hoped- disarmament by definite decisions.

Credible data on the state of military forces in both opposing sides have been available for a long time. How and what could and should be reduced is, however, a subject of long-lasting bargainings.

The Mutual Force Reduction Talks in Vienna, for example, have been going on for years. The only encouraging thing which could be said about them is the fact that the talks continue. It is quite obvious that the problems raised at the MFR talks are

much more difficult and complex by nature than any other questions, perhaps with the exception of SALT.

There are still a lot of questions left open: What is the scope of force reduction? Should disarmament refer only to the number of troops or, at the same time, to the number of weapons, tanks, aircraft, missiles and nuclear bombs as well? Should the number of withdrawn forces be nearly equal on both sides absolutely or should there be a percentage reduction? How could the principles of mutual advantage, equal security and status-quo be taken into account? What should be the first steps? How could further expansion of the forces be avoided during MFR talks?

Another and even more significant problem is SALT. At the Vladivostok meeting in November 1974, the leaders of the world's two most mighty powers achieved a breakthrough that could slow down the costly and perilous arms race. The joint statement, signed by President Gerald Ford and the General Secretary of the CPSU Leonid Brezhnev, firmly established the guidelines for the second round of SALT negotiations, restricting offensive nuclear weaponry by limiting both big power's arsenals of intercontinental missiles and bombers. What is of paramount importance, Ford and Brezhnev came to terms on two basic principles. Firstly, they fixed the same number (about 2400) of strategic delivery vehicles - such as bombers, land-based and sea-based missiles - which would be permitted at each side. Secondly they agreed to work out a ceiling on the number of missiles (about 1320) that can be equipped with multiple warheads (so-called MIRVs).

However, no new results have been achieved for three years. The Moscow talks between representatives of the two mighty powers in the spring of this year ended without success. The negotiations are, however, going on and both the United States and the Soviet Union remain hopeful that a new SALT agreement can be reached perhaps by the next autumn.

It is quite obvious that political détente must be followed by serious disarmament agreements. Otherwise détente would be in peril and interstate relations would become limited.

Despite all obstacles, miscarriages and failures, détente seems to be the order of the day. This is valid both for Soviet-American connections and for the relationship between Western and Eastern Europe. There is no realistic alternative to détente, which is the only way to avert disaster of mankind, and consolidate peace.

Hopefully, this Pugwash meeting will facilitate the discussion of unresolved questions, and will promote the further development of détente and disarmament.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

F. Kohler (Austria)

BEFORE THE CRISIS

Three years ago, many colleagues like myself had feared a continuous increase in global energy production, leading ultimately to a climatic or environmental disaster. This foreseen increase in global energy production was expected to widen the gap between industrialized and less developed countries. The conclusion was to diminish the rate of energy consumption in the industrialized nations, and to promote population control in the less developed countries, in order to diminish the inequality in the per capita energy consumption within a moderate increase of global energy production. An optimistic, but not unrealistic scenario by J. Holdren, estimated the increase in global energy production to be fourfold within the next fifty years.

In some respects, the situation has changed in the meantime. Previously, it was our concern to go slow on increase in energy production in order to prevent a big catastrophe (of political, environmental or climatic nature) after some decades. Now, it seems to me that the feared increase in energy production will not be possible at all, but we will have to face an energy shortage soon. This might be a good thing, as it will force us to change our affluent style of living and adapt our economy to ensure at least the same quality of life for the next generations as we have today. But it will be necessary to be prepared in order to avoid the worst political and economical shocks.

Let me give the reasons for my opinion. Possible large-scale energy sources for the next decades are coal, nuclear fission, and - hopefully - solar energy. I discount fusion and geothermal energy, not expecting large-scale installations within the next decades.

The present distribution within energy sources is (on the basis of 1972) 32% coal, 65% oil and gas, more than 1% water power, and about 1% nuclear energy. Let us assume, that these sources will

contribute the same absolute amount in the future, and let us ask which source will furnish the threefold extra amount in global energy production for 2025 in Holdren's scenario.

On coal basis, this would mean an increase in coal use by a factor of ten. Though theoretically not impossible, it would need an ideal industrial management and the absence of political or sociological difficulties. Even for the United States, where 210 coal mines are expected to be opened between now and 1990, when the coal industry should double its recruitement within the next ten years, and when the western railroads think of tripling their cars available for coal transportation between now and 1980, this will be near or beyond the limit of feasibility. On a global basis, I can't believe that such an increase of coal use can be put into effect.

Should the threefold extra amount of global energy production be covered by nuclear fission, then nuclear reactors must be multiplied by a factor of 300 within the next 50 years. Political and environmental pressure has grown so much against nuclear energy, that this seems practically impossible - luckily enough for future generations.

Now let us inspect solar energy and include here all indirect uses of solar energy like hydropower, wind mills, forestry. Though it should be our aim to make use of this energy source as much as possible, we have to be aware of the fact that only a small fraction of the total energy reaching the earth can be put to use. An optimistic estimate - based on a harvest of 20 W/m^2 and a collector area of 100 m^2/cap. - has shown that we will perhaps be able - if the technological development has been successful - to satisfy the present global energy need. But this is very probably an upper limit.

To conclude, it seems unlikely that even the increase in global energy consumption as suggested by Holdren's scenario can be covered by coal, fission, or solar energy.

As a matter of fact, the installations of nuclear power plants have been delayed already in the USA and West Germany. The technological development of solar energy is slow. Coal is on the way in the USA, but only there, and the development will probably stay behind the present expectations - hopefully for the environment. Though no rapid energy shortage is to be expected - it seems that growth in energy production will soon become a limiting factor in economic growth.

What will be the consequences? In our present economic system, unemployment among the industrialized nations, and very poor conditions in the less developed countries. Any crisis will do most harm to the poorest. Also, any crisis endangers irresponsible actions.

What can be done to prepare for the crisis? With respect to technological developments, a change in priorities: solar (direct and indirect use) before coal, and coal before fission. Instead of making propaganda for electric appliances, and developing the electric network, conservation of energy should be our first goal. Furthermore, hydrogen should be put to use as energy carrier, which can be stored and can be transported over relatively large distances. But much more important than technological solutions is a change in the whole economic system. Our world, capitalistic and socialistic countries alike, still aims at maximum economic growth. Even the labour unions use economic growth as criterion for their political decisions in the (in my opinion wrong) belief that economic growth and employment go parallel. Therefore, it seems to me most urgent to develop models which aim at zero growth for the industrialized nations, and at qualitative growth, coupled with some self-sufficiency, for the less developed nations; these should ensure employment on the basis of more public services, by which the quality of life can be enhanced at even diminished material standards of living. But to assess these models we would need a new value system for which only a few attempts exist. The promotion of such economic models would be an extremely important and urgent task for Pugwash.

This document has been specially prepared by Professor Galal as convener of Working Group 4. It is intended to serve as a basis for discussion by the Working Group in Munich, and for working papers submitted by participants. The latter should not exceed 10 double-spaced typewritten pages, plus a 250 word abstract for possible publication in the Pugwash Newsletter.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

E. E. Galal (Egypt) XXVII-17

SECURITY OF DEVELOPING NATIONS

The security of the developing countries can only be considered in the light of the experience of the last quarter of this century, as well as in the light of emerging development in the international scene.

From the purely military point of view the picture is more than disquieting: SIPRI (1) estimates 119 wars (civil and international) to have taken place between 1956 and 1975. The sum total of these conflicts exceeded 350 years, and involved the territories of 69 countries and the armed forces of 81 states. Several tens of millions of people were killed in these wars. On any single average day about 12 wars were bleeding the developing countries.

The casualties, and the political and economic damage as well as the suffering and social disruption, were beyond any estimation.

For comparison, hardly any wars (apart from Greece) involved the European or North American continent during the same period, and only 24 wars according to Quincy Wright (2) had taken place in the whole world between 1900 and 1941.

Non-military threats or indirect threats have been equally real and effective. To pin-point only the dramatic contributions of one major power one has to remember the down-fall of Mossadek in Iran 1953, Guatemala 1954, Lumumba in the Congo, the Bay of Pigs in Cuba in the sixties, Laso and Chile in the early seventies. The total list is very probably not much shorter than the military one if ever the day will come for it to see the light of truth.

What is more significant is the integral function of the two physical threts to security; military and subversive.

In analyzing the local wars in Asia, Africa and Latin America during 1945-1969 SIPRI concludes: "the main type of war in our age is the war fought within the boundaries of a single country with the aim to overthrow a given regime or government and bring about changes in power. Predominant are, within this type, wars waged with the participation of the forces of foreign countries." (3)

The developing countries, of course, offer golden opportunities for such

manipulations. Political and economic instability is rife and often exacerbated by international forces. Particularly in Africa and the Indian subcontinent, the end of a long era of colonialism left many artificial boundaries reflecting historical imperial balances rather than ethnic or historical realities. Trends opposing integration and harmonization were not simply ignored but often manipulated and suppressed to safeguard imperial domination.

Many nations faced so-called "Independence" day with no basis for national unity except a newly invented flag and inherited armed forces. More effective of course was the sponsoring major power.

In other corners of the world, the Middle East, Rhodesia and South Africa, an inplanted foreign ethnic minority created even more explosive and malignant bases of conflict. In yet other corners of the world division of ethnic historical units, Korea and Vietnam, to reflect the demand of the world bipolar hegemony, was not much less effective.

In all events the inherent instabilities, weaknesses and divisions of the developing countries were viciously compounded by their inevitable involvement in the monstrous games of the competing bipolar hegemonies. For the dominant powers fighting their battles in, and with, this peripheral fringe of humanity is a much less expensive and risky outlet for their antagonisms. Often, for the competing, unrepresentative local factions it is the surest way to power and profit. For the common man in the developing world, the enforced merry-go-round of "protective" umbrellas did not only exact their price from his freedom of choice and peaceful development, but unlike his counterpart in the developed world, showered him with an unprecedented hail of death and destruction.

Moreover, the outcome of this situation of impending threats to security has many far-reaching results which by throwing their long shadows over the future of the developing countries may have even more disastrous long-term results than the immediate killings and suffering.

First, in addition to the developing countries more than fair share of internal and regional conflicts and instabilities, reflecting their historical realities and heritage, they are perpetually drawn into unrealistic and often irrelevant very expensive international confrontations which are hardly concerned with developing countries urgent needs or concerns.

Second, in addition to the squandered opportunities and priorities there is the economic drain of the arms race. In the last 10 years developing countries

increased their military expenditure by 90 percent in addition to the 4 billion dollars in foreigh military aid received by these countries. (4)

The value of arms trade with the third world countries in the period 1950-1975 is estimated to be $ 40 billion. In the last few years the rate of expenditure has accelerated: "the growth in this trade can only be described as explosive. The arms trade is now virtually out of control. A total of 95 countries imported major weapons (such as missiles, aircraft, ships, tanks (and so on) in 1975 ..... The actual value of the global traffic in weapons, equipment and related services can only be guessed at, but a reasonable estimate is about $ 9 billion per year with new orders running at about $ 20 billion annually ..... Perhaps of greater significance than the rapid escalation ..... The most sophisticated conventional weapons systems are being demanded and received ... moreover many recent arms contracts go far beyond the transfer of weapons - they include training, technical support, the establishment of maintenance, etc. ... The spread of sophisticated weaponry obviously raises the level of violence, should conflict break out .... such weapons have enormously raised the cost of acquiring and operating todays armed forces..." (5) A newer trend is the significant transfer of military technology to hot areas of conflict.

Thirdly, the divergence of urgently needed resources in addition to the squandered opportunities does not, unfortunately, represent the total extent of economic damage. "There is another link between arm supplies and economic development, which arises from the role of arms suppliers as one element in the hegemonic relationship between suppliers and recipients. This relationship, in turn, influences the economic structure of recipient countries and the economic policies of recipient governments." (6)

"Third World nations wishing to buy or even produce weapons more sophisticated than rifles, machine guns or mortars are dependent on the goodwill of the governments of a few industrialized countries, in particular those countries with scarce foreign exchange resources are dependent on the goodwill of the two super-powers." (7)

There is little doubt that the author of this paragraph intended to enclose "goodwill" in quotation brackets, the political, economic and military price exacted can hardly, in most cases, be included among expressions of "goodwill" by any stretch of the imagination.

Fourthly, the "goodwill" of the suppliers is often a facade to the "goodwill" of the private interests of the Multinationals as has been amply demonstrated by

I.T.T. in Chile, Lockheed in the four corners of the world, fruit monopolies in Central America, gold and uranium interests in South Africa, copper in the Congo, and oil and Suez Canal company in the Middle East. The spectrum of pressures, manipulation and downright subversion offered by these examples has been the subject of detailed, though far from complete investigations.

Two main international trends have had, and will continue to have, significant meaning to the security of developing countries, i.e. détente and non-alliance.

During the height of the cold war, confrontation of the two hegemonies threatened the very existence of the human race. The threat is far from being removed, but an escalating balance of terror seems to lay the foundation for a mode of "co-existence" among the giants. The rules of the new game are still unfolding. Yet it is becoming more and more evident that while central frictions (involving the forces of the two giants directly) are meticulously restrained, peripheral frictions involving non-recognized spheres of vital interests of any of the giants are growing.

One apparent very recent development is the reluctance for any direct military involvement in these peripheral frictions by both camps. So the Korean, Vietnam and the Suez Canal examples seem to be receding, but the Angola model seems up for promotion. The implications to the incidence of war and arms race are too obvious to enumerate.

Non-alliance as an alternative option to the assimilation by one or another of the opposing hegemonies had its days of glory. During the rise of the tide of liberation movements and the free wheeling maneuvering for positions by the opposing camps, there were opportunities of balancing or even playing one camp against the other. With the third world exhausting its revolutionary potential and settling down to the harsh realities of development, and détente delineating the possible and the permissible, the political and military significance of non-alliance was almost contained. The new rise of economic confrontation between north and south is a much more manageable trend from the point of view of détente as it poses no real alternative to bipolar hegemony. In a sense this is a loss to all sides concerned. The build up of non-alliance and its implications of bolstering third world capabilities of shouldering the responsibilities of its own future through global and independent regional associations, could prove to be a less expensive and risky alternative to universal bipolar hegemony, even from the point of view of the super-powers.

With all its limitations and failures, the UN still offers the only positive vehicle of assuring the security of the developing countries. It is surprising therefore that no more concern and efforts are dedicated, by these countries, to strengthen and extend its effectiveness.

This international approach is justified by the basic common features underlying the deteriorating security of developing countries. These common features are illustrated by the exploitation of the developing countries basic economic and political defiencies and divisions for ulterior international purposes opposed to the real need of their security, independence and development.

The extent of the cost of these exploitations to the security, independence and welfare of these countries has been amply demonstrated over the last quarter of a century. The superficial shifts in the practices of the opposing camps do not hold any promise of a meaningful amelioration of this situation. On the contrary there are indications of further intensification of the risks and damages by further expansion of so-called conventional arms trade as well as proliferation of atomic weapons. An already detected upgrading of the cost in human life, suffering, and political, economic and social disruption is alarmingly mounting.

Only the radical shift, by the opposing camps, to a policy of peaceful free competition with total disarmament and an end of world hegemony can place them in a position to reverse their dominant contribution to the insecurity and sufferings of developing countries.

In the absence of such a radical shift a struggle towards a semblance of a just and effective world order is the only available alternative to the anarchy and suffering resulting from the inability of developed countries to match their power by corresponding responsibility.

As U.S. Representative John Breckinridge (D. Kentuky)put it in 1975. "We must not lose sight of the central fact that hunger constitutes the gravest threat of all to world peace, of the very ability of the human race to survive..... Fewer empty stomachs will reduce world tensions, pressures and the prospects of wars for ourselves and our posterity." (8)

N.B. See also the author's background document "A 'Complete' Look at Nuclear Weapon-Free Zones", prepared for the Pugwash Workshop on a Draft Treaty on World-Wide Nuclear Weapon-Free Zones, Geneva, 14-15 April 1977. This document was reproduced in the April 1977 issue of the Pugwash Newsletter.

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This document has been specially prepared by Professor Smith and colleagues. It is intended to serve as a basis for discussion by Working Group 7 in Munich, and for working papers submitted by participants. The latter should not exceed 10 double-spaced typewritten pages, plus a 250 word abstract for possible publication in the Pugwash Newsletter.

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ENVIRONMENTAL HAZARDS OF GLOBAL CONCERN

INTRODUCTION (P. B. Smith)

There is no general agreement that there is an environmental crisis. The philosophy that man, as one of earth's creatures, must learn to live in harmony with the world around him has had little effect on the dominant philosophy of our civilization that nature exists for the sole purpose of being of use to man. For this reason the sometimes acrimonious conflicts on environmental problems generally revolve about the question as to whether the useful effects (usually measured in economic terms) of a given pollutant or polluting process weigh up against the value of the natural systems (generally considered as having purely emotional, or sentimental value) destroyed. There is very seldom sought for the most harmonious (in the sense stated above) solution.

Despite the hesitation mentioned above, there will be presented in this paper a short summary of some points of danger in the interaction of man with his environment.

Although there are many thousands of deleterious pollutants and nuisances produced by human activity most of these are of relatively local concern and others, while being very wide-spread, produce essentially reversible effects. We will here concentrate on a few of the products of human activity where there is reason to believe that the deleterious effects could be both global and irreversible. The time scale of irreversibility must be chosen reasonably. With enough millennia at one's disposition even the actinides created by nuclear power production can be considered to be a reversible pollution, but it would be absurd to take a decision on nuclear power based on this time-scale of reversibility. For dangerous chemical pollutants it seems certain that several centuries will be sufficient for natural degradation to cause the pollutants to completely disappear, even in the worst cases, but for some of these there is a more fundamental and lasting ecological effect: the destruction of specific species, in particular at the top of the food chain, as in the case of DDT. It seems possible that this sort of ecological damage will be eventually repaired but one must think in terms of many millions of years. Again, measuring in human terms it would be wrong to dismiss the danger as transitory.

In the following we will concentrate our attention on dangerous pollutants or processes for which irreversible ecological damage can be expected, or for which such damage is thinkable. We define *irreversible* to mean *persistent* (either as pollutant itself, or the effects thereof) for a "long time" in human terms (more than one generation).

DEPLETION OF THE OZONE LAYER (P.B. Smith)

Several reports including studies of the U.S. National Academy of Sciences and the U.S. Department of Transportation[1] have pointed out that large scale use of supersonic aircraft may cause significant depletion of the ozone layer due to discharges of nitrogen oxydes. Impacts were estimated in the studies mentioned to be in the order of 1% depletion of the ozone layer per 1000 h flown by supersonic aircraft like Concorde or TU-144 in the stratosphere.

It has also been suggested that other, more down-to-earth

sources of nitrogen oxydes like fertilizers may contribute to thinning of the ozone layer[2].

Furthermore, there is strong evidence that the ozone layer may be harmed by the release of halocarbons that liberate chlorine atoms on photolysis by ultraviolet light. These chlorine atoms may destroy ozone. A study by the U.S. National Research Council suggests that continued release of halocarbons at a rate corresponding to its use in 1973 will eventually produce somewhere between a 2 and 20% reduction in stratospheric ozone, with the most likely figure being 7%[3].

ECOLOGICAL AND HUMAN EFFECTS OF DEPLETION OF THE OZONE LAYER

(Ph.B. Smith)

At this stage it is quite impossible to make any estimates of the ecological effects of an increased UV level on the ecological systems of the biosphere. It seems impossible to imagine a mechanism by which enhanced UV radiation could influence marine life. A thin layer of sea-water will absorb any extra UV present (70 cm half-thickness at 3000 Å, compared with 44 m for 5000 Å; the latter figure leads to a 150 m thickness in which photosynthesis effectively takes place) so that a process needing a certain dose will take place at the appropriate depth. Deleterious effects seem to be unimaginable, since a greater mutation rate in the first one or two meters due to enhanced UV levels can only produce mutants which have to survive in competition with the immensely greater biomass up to the above-mentioned depth of 150 m.

The situation is different for land animals and plants, and it is the latter where the greatest danger of damage lies. In evolutionary terms land plants are later arrivals than sea flora, and quite possibly could profit from an ozone protective layer from the very onset. Even if this had not been the case we can be reasonably sure that evolution, due to an enhanced mutation rate, would have taken a different course depending on the UV dose. It is completely impossible to form a meaningful opinion on the question as to whether a different course would have been more or less "favourable".

We must therefore conclude that as far as land ecosystems are concerned we cannot be sure at all of either magnitude or

direction of the effects of an increased UV level. Given the uncertainties, but accepting as irrefutable that genetic effects of some sort are certain, to those who feel that man must live in harmony with his natural environment, it would appear to be very foolish to bring about long-term changes in the ozone layer. Unfortunately as explained in the previous section, there is evidence that industrial, transportation and agricultural processes, now lying at the basis of industrialized life in our civilization will bring about very slow (in human terms) and long-lasting depletion of the ozone layer.

Much more is known about the effects of UV radiation on human beings than on ecosystems. A summary can be conveniently found in a review paper prepared for the UN Environment Programme by experts and submitted by WHO (ref. 4). If we disregard acute effects which are not relevant to the present discussion of the possible effects of long-term, relatively small (5-25%), changes in the UV dose rate, we can conclude that there definitely will be an increase in skin-cancer incidence among light-skinned populations, and that the lighter the skin the greater the effect will be. Assuming a slow decrease in the ozone layer to a new equilibrium value and consequent increase in UV radiation it could easily take a century before the skin-cancer rate of incidence reaches equilibrium at a higher level.

Studies attempting to follow this effect will be seriously hampered by the fact that at present there is a widespread increase in skin cancers[4], probably related to cultural changes (changes in clothing styles, popularity of sunbathing, reduced use of hats, etc.). Nonetheless, apart from any measures which the working group wishes to recommend with respect to abatement of those influences tending to reduce the ozone layer, the author would like to see strong support of the recommendations given in reference 4, namely:

1. Evaluation of present knowledge

All available data on the health and other biological effects of UVR should be collected and evaluated with a view to establishing dose/effect and dose/response relationships summarized in criteria documents. These are needed to obtain a balanced and critical evaluation of existing information which is available at national level. This would be of direct benefit to countries not in a

position to carry out the necessary studies themselves.

2. Recommendations for further research

2.1. Monitoring of solar UVR. An internationally coordinated network of ground-based stations for the measurement of UVR with uniform internationally standardized methods should be established. Some of these UVR measurements should be made at sites where detailed epidemiological studies of skin-cancer incidence are in progress, so that corresponding UVR data can be obtained for assessing the dose-response relationship of UVR and skin cancer.

2.2. Epidemiological studies. An epidemiological programme is needed for the monitoring of melanoma and non-melanoma skin-cancer incidence in various parts of the world. So that valid comparisons may be made. Any such programme would have to be carried out in accordance with a uniform protocol covering not only UVR and genetics but other pertinent environmental factors as well. Data thus collected on UVR intensity and distribution, and on population skin-doses (from personal dosimeters that should be developed) could also be used as the basis of prospective cohort studies.

2.3. Development of criteria and methods for identifying populations at greatest risk. Populations studies on the prevalence of skin cancer strongly suggest that persons with certain skin characteristics (fair skin, light eyes, freckles) sunburn easily, tan poorly and run a greater risk of developing skin cancer, and that this is a genetic trait. Simple screening methods should be developed to identify the most suscceptible members of a population.

2.4. Beneficial effects of UVR. Beneficial effects of UVR have been reported but are insufficiently documented. It is therefore suggested that potential beneficial effects of UVR, as well as the adverse effects of UVR deficiency be further investigated.

2.5. Experimental research. More extensive studies are needed on the fundamental effects of UVR at molecular and cellular level, in particular on the photochemistry of macromolecules

(including DNA damage and repair), metabolic and cytogenetic effects on cells and cell constituents, on the nucleus and cytoplasm, and the significance of such effects for the induction of photobiological effects, including cancer.

REAL AND POTENTIAL DANGERS OF GENETIC ENGINEERING (A. Quispel)

The development of the techniques for genetic engineering and its real or potential risks has led to many discussions and serious controversies among scientists and between scientists and the public (journalists, lawyers etc.). Since the deliberate moratorium by a group of American scientists on this type of experiment until more insight into the risks involved is obtained, a number of guidelines have appeared for safe research with recombinant DNA, and introduction of this recombinant DNA into bacteria. We mention the guidelines of the National Institute of Health in U.S.A. and the Williams Report in the United Kingdom. Many other countries have accepted these guidelines in a more or less modified form. Still the question can be asked whether such guidelines are sufficient, or whether such type of research must be postponed or even forbidden entirely.

When considering the dangers of a certain type of research we must make a clear distinction between real and potential dangers. Introduction of a type of DNA coding for a highly toxic protein into an ordinary coli bacterium certainly is a dangerous experiment, since spreading of this modified bacterium might have extremely dangerous results (at least if this bacterium is able to survive in the natural selection with the normal strains). In most type of experiments which are proposed there is no reason to expect any dangers at all, and most probably there is no danger. However, because such DNA recombinations have never been done before we are not sure that dangers are absent and therefore we must take precautions. Most probably such precautions are superfluous because there are no dangers, but because we are never sure about it we will continue to be careful. This difference between our attitude against real and potential dangers is too often neglected or misunderstood in the discussions.

Genetic engineering is merely a method which can be applied for different scientific purposes and might give rise to practical applications. In other fields of scientific research there is

a general opinion that scientific research as such is "value free" (wertfrei), but that ethical aspects arise as soon as the results are applied. Genetic engineering is one of the first examples where the research itself is considered by some as ethically irresponsible. It is considered irresponsible because the danger of accidents is too great or because we know that the results inevitably will lead to future applications for which mankind is ethically unprepared.

The real or potential dangers of these experiments consist of the possible escape of extremely dangerous new types of bacteria from the laboratory. This danger is highly overestimated as it is very improbable that such modified bacteria have any selective advantage as compared with the normal types. However, this selective advantage can never be fully excluded. The different guidelines propose two types of safety measures: physical containment and biological containment. Physical containment consists of laboratory safeguards to prevent escape of bacteria or viruses. However efficient these might be, technical or human failures can never be excluded. Biological containment consists of the use of bacterial mutants which can only exist under very special laboratory conditions, so that their survival outside in the natural environment or in our bodies is impossible. A fully reliable bacterium of this type is not yet available; if they are developed, the chance of accidents can be considered to be zero.

Even then we must realize that the technique, when applied not only to bacteria but to cells of higher plants and animals might eventually enable us to perform genetic engineering on human beings. The ethical problems then arising are enormous. Yet we must realize that such methods, if they are ever available, will be the only way to eliminate genetical aberrations.

A far greater problem than the prevention of accidents in most probably entirely harmless experiments by reliable and responsible scientists is the prevention of really dangerous experiments, which are forbidden, by irresponsible scientific criminals for military or paramilitary purposes. This danger is not prevented by official guidelines where such experiments are prohibited, as long as no legal measures are taken all over the world to prevent such research, to prohibit any secret research with recombinant DNA, and to punish any trespassers as serious criminals against mankind.

A COMMENT ON THE CONCEPT OF SAFETY UNDERLYING THE GUIDELINES FOR DNA-RECOMBINANT RESEARCH (L. Reijnders)

In several countries including the USA, the UK, the FRG and the Netherlands guidelines have been published that are intended to reduce the risks of research on recombinant DNA to an acceptable minimum level. In my opinion all guidelines published so far are based on an inadequate perception of the problem. This inadequacy relates mainly to the following two matters:

1. Current guidelines have as aim the imposition of increasingly stricter safeguards to the degree that the risk increases that the experiment in question *performed as planned*, might make a potentially dangerous micro-organism. They do not take into account the possiblity that potentially dangerous micro-organisms can be made *accidentally*, due for instance to (common) occurrences such as infections of laboratory cultures, contamination of enzymes by nucleic acids (endogenous or introduced during enzyme-purification e.g. on DNA-cellulose columns), mixing up of vials etc. Guidelines seeking to reduce the risk of *accidental* creation of potentially dangerous recombinants to an acceptable minimum would probably differ significantly from current guidelines, especially for DNA-recombinant research that is currently classified in minimum or low-risk categories.

2. It is highly doubtful whether current guidelines are based on a sufficient appreciation of evolutionary perspectives. As has been pointed out by Eigen[5] it is plausible that not all fitter species have come into existence because of the phenomenon that evolutionary pathways leading to these fitter species may go through "gaps" of lowered fitness. The construction of DNA recombinants may bridge those gaps of relatively low fitness, and so may provide a starting point for new evolutionary pathways.
   In such cases gaps may be bridged and where those pathways may lead us is uncertain. Current knowledge in the field of biology does not allow for very reliable predictions in this respect.
   This leaves open the possiblity that the work on DNA-recombinants may (in the long run) cause large scale irreversible ecological changes; this also creates major unsolved problems

in establishing a framework for safety measures and sheds doubt especially on the long-term safety of recombinant experiments currently considered to belong in the lower-risk categories.

From the perspective outlined one may wonder whether it would not be wiser to (re-) instate a moratorium on DNA-recombinant research. This moratorium may then be used to re-evaluate current guidelines and to investigate whether there are acceptable alternative strategies to reach the scientific and social goals that may be reached by DNA-recombinant research.

RADIOACTIVE WASTE DISPOSAL (Ph.B. Smith)

At the 23rd Pugwash Conference in Aulanko, Finland Working Group 5 drew attention to the potential dangers to the environment of nuclear energy. With respect to the present topic it seems wisest to restrict our discussion to waste disposal, although insufficient reactor safety could easily also provide a dangerous threat to the environment.

The reactor safety issue is, however, full of uncertainties. These uncertainties are not the frequently voiced platitudes on the difficulties of evaluating the risk of "events with a vanishingly small probability of occurrence but of disastrous effect" but simply uncertainties due to the fact that applied design techniques[6] and risk analyses in the reactor industry[7,8,9] are demonstrably much less than optimum. According to testimony presented recently by three reactor-safety specialists[6] inadequate safety provisions even make the occurrence of a serious disaster virtually inevitable. The officially estimated accident probability may therefore be off by several orders of magnitude due to the idealized calculations[7,8,9].

The problem of radioactive waste disposal is also fraught with uncertainties. One thing is certain, however, namely that *there will be* large quantities of nuclear waste if a full-scale nuclear energy program with recycling is started. On this point there is no uncertainty. That alone justifies a thorough treatment of the subject by the working group.

There have been many publications on the subject of fission product disposal, some bordering on science fiction. Very recently, however, B.L. Cohen published an article in the Reviews of Modern

Physics[10] in which he concludes that "these wastes pose far less of an environmental threat than the original uranium ore". Since this is the most thorough treatment yet to appear, I will limit my comments to this article alone.

I find it remarkable that rather detailed descriptions are given by the author of the consequences of disposal procedures, whereas the principle technological steps involved, namely the incorporation of high-activity fission products in large glass rods encased in steel canisters, and the subsequent burial of these canisters in some carefully chosen geological formation, have not yet been carried out.

Although few would agree that the real problems created by high-level radioactive waste are primarily technological (see under), it is nonetheless useful to point out that from a technological viewpoint the calculated probability of wastes reaching the biosphere at a dangerous concentration level begin essentially at the point in time when a given mine shaft is expertly sealed off with, for instance, a several hundred meters thick concrete plug. This explicit assumption leads to the result desired by the author, but not mentioned is the (implicit) assumption that during the many decades in which a given mine is active, there be *no* interruption of authority or surveillance. It should suffice, I believe, to mention one highly probably scenario which is ignored by Cohen. Any old mine where the shaft has fallen into disrepair can be expected (this is not a "small probability" but a virtual certainty*) to slowly fill with ground water due to ruptures and imperfect sealing of the shaft to the surrounding rock**. In order to determine what the consequences would be, one could, as Cohen does for the scenario which he uses in his calculation, make a number of purely ad hoc assumptions concerning the contamination of ground water in contact with the shaft caused by convection currents brought about by temperature gradients. I feel that this sort of "working toward the right answer" is not entirely proper.

The effects of inclusions of brine calculated by Cohen are dependent on a particular model of a salt layer. It is known that these inclusions are irregularly spread in salt layers. It should

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* except in truly desert regions where there is essentially no ground water.

** In the Netherlands serious plans are being made to dispose of waste where the ground is at or below spring tide, and only protected by dikes from being flooded in storms.

therefore be born in mind that although the investigation of a large number of small borings around each canister could reduce the danger arising from a large inclusion close to the canister to small proportions, the economic consequences of requiring such an investigation prior to approval of a boring could be extreme. The same must be said for the presence of inclusions from which, due to heating, chlorine gas could be (unexpectedly) produced, bringing with it difficulties in surveillance.

Cohen also calculates the effects on the population of a scenario in which radioactive wastes are uniformly spread over the continental US in order to show that the effects are negligible. Not that his scenario is relevant to the problem at hand, but if it were it should be mentioned that occurrence of food-web concentrations of some of the most dangerous radio-isotopes completely invalidates the conclusion.

With respect to Cohen's neglect of exposure of unborn children because only 1% of all exposures take place in this way, it is relevant to note that as far as is known, *all* people spend approximately nine months in the uterus.

CONCLUSION

By far the greatest risks from radioactive wastes are, of course, unrelated to the scenarios used by Cohen. Not considered are transportation risks (which are, at least, according to all statistics, very large) and the, at present, too little known risks associated with reprocessing plants. These would appear to be in any case many orders of magnitude larger than correctly buried waste, which in turn are, as mentioned above, much larger than those associated with the scenario of correctly buried waste in ideally sealed-off mines which is the only case thoroughly treated by Cohen.

The conclusion seems to me to be warranted that the effective risks are uncertain by many orders of magnitude, and that this factor alone continues to make radioactive waste disposal one of the most serious problems of large-scale nuclear power application.

KRYPTON-85 (Ph.B. Smith)

If reprocessing of nuclear fuel is ever to be permitted on a large scale the problem of gaseous releases will have to be taken very seriously. The problem, in particular, of retaining krypton-85 on an industrial scale, without enormous costs, is difficult.

Initially the inert nature and resultant total biological inactivity of krypton led to the logical conclusion that it would be only necessary to release this to the atmosphere[10] under conditions in which good mixing occurred. Recently, however, certain indications that this may not be so simple have led some authorities to require that reprocessing plants be designed so that the krypton-85 will be retained.

The danger in this case is that of involuntary weather modification. Boeck[11] has shown that uniform mixing in the atmosphere, leading to 1% of the present MPC of Krypton-85 will produce an excess of 40% increase in atmospheric ionization at sea level. One percent of MPC is not an unreasonable concentration if full-scale development of reprocessing is allowed. No one can say with any certainty what effect such an increase in ionziation will have. I am not inclined to worry too much about it, but on the other hand if it is at all possible to retain the krypton-85 it most certainly should be done.

POLLUTION DUE TO ENERGY PRODUCTION IN GENERAL (Ph.B. Smith)

This subject falls properly under the subject matter to be treated by working group 6. Nonetheless, since I have put very definite criticism at the door of those contending that radioactive waste in fact is not a problem, I hasten to point out that there has as yet been no energy-production system developed, which, if carried much further than the present-day level, will not create serious pollution problems. Working Group 5 at Aulanko and Working Group 6 at Baden have also considered this problem. No amount of care in the handling of radioactive waste, nor in scrubbing the smoke from coal and oil burning will ultimately help. It seems to me that the only solution for growing energy needs, in particular in view of the growing needs in the third world, is an all-out program of utilization, at all levels of sophistication, of solar energy. It remains difficult for me to understand why the technological community refuses to take up the challenge to provide mankind with an environmentally compatible energy source *for ever*. I can only find the explanation in the lamentable mental attitude mentioned in the introduction: namely that the existence of "nature" is an unfortunate "mistake" and that it is man's destiny to destroy it as thoroughly and fast as possible.

WEATHER MODIFICATION (Ph.B. Smith)

The US-Soviet draft treaty presented to the Conference of the Committee on Disarmament (CCD) has a great number of indadequacies. It does not seem impossible to eliminate these deficiencies, but there is need to make haste. We quote the SIPRI yearbook (1976)[12] on this subject:

"The draft required that the complaints procedure should be carried out "in accordance with the provision of the Charter of the United Nations". Since the Charter provides that Security Council decisions on substantive matters should be made by an affirmative vote of nine of the 15 members of the Council, including the concurring votes of its permanent members - China, France, the UK, the USA and the USSR - each important step in the process of verifying allegations of breaches of the convention could be blocked by a negative vote by one of the great powers. There can be no doubt that this right of veto would be taken advantage of whenever an accusation were directed against any of these powers or their allies. Considering that at the present time, and probably in the foreseeable future, the most likely offenders are precisely the great powers, or some of their allies, which are the only states engaged in large-scale research and development of environmental modification techniques, the verification provisions as formulated in thedraft, were devoid of practical significance.

"No treaty can change the prerogatives of the permanent members of the Security Council as long as the UN Charter remains unchanged. But there is, perhaps, no need to involve the Security Council in the implementation of a convention concluded outside the framework of the UN machinery and to resort to the services of the Security Council in view of its responsibility for the maintenance of international peace and security, there appears to be no reason why a single body, whatever its standing, should combine the power of conducting investigations with that of determining the guilt or innocence of states with regard to the observance of a treaty. Separating the fact-finding duties from political judgement could render the verification provisions more plausible.

"Constraints on new weapons before they have been fully developed, and especially on warfare techniques which are inherently indiscriminate and unpredictable in their effects, could as preventive measures, contribute to the circumscription of the arms race. But to be effective, the constraints must be comprehensive

and contain no loopholes. The US-Soviet draft convention on the prohibition of environmental modification techniques did not meet the above requirements. It would ban the use of these techniques, without banning their development. Moreover, even the non-use commitment was qualified. It was limited to those techniques which produce widespread, long-lasting or severe effects, and which, because they are of uncertain effectiveness, unpredictable and double-edged, that is, potentially hazardous to the user himself, can hardly be conceived as weapons of war. On the other hand, the techniques which do not produce widespread, long-lasting or severe effects, but which could be important in tactical military operations because of their ability to hit more precisely a selected area, would escape the ban. Another important drawback was the lack of an impartial machinery to establish facts of violation. The proposed complaints procedure depending entirely on the good-will of the permanent members of the Security Council seems to be of little value. Elimination of these, as well as other shortcomings described above, could make the contemplated agreement really meaningful."

HEALTH-RELATED MONITORING (Ph.B. Smith)

Several of the subjects mentioned in this paper as well as countless other sources of pollution, may cause health damage. Besides the problem of weighing the alternatives of "economic" losses against "environmental" losses there is very frequently considerable uncertainty concerning the real extent of surmised health damage cuased by different pollutants. In order to diminish this uncertainty a program of pollutant monitoring, especially keyed to circumstances where medical statistics make it possible to carry out a meaningful search for correlations with human health, has been proposed by the WHO and UNEP secretariats[13]. The proposal makes use of advice from expert consultants. This excellent proposal should be supported by the Working Group.

In a recent study[14] made by the Groningen Centre for Environmental Studies on the possible operationalization of the "Standstill Principle" for the European Community it is recommended that the European Community adopt the procedures described in WHO/UNEP paper.

There is, of course, no guarantee that the results of such monitoring activities will produce any effect on social, economic, and industrial developments. To simply cry out that the ship is

sinking does not keep it afloat. Nonetheless it is a positive symptom that awareness along these lines is growing.

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27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

F. Perrin (France) XXVII-19

A LIMITED NUCLEAR WEAPON-FREE ZONE IN CENTRAL EUROPE

During the past few years the possibility of establishing nuclear weapon-free zones of different patterns has been discussed in the Pugwash Conferences, with general agreement that nuclear weapon-free zones would lessen the risk of a nuclear war.

A first nuclear weapon-free zone consisting of several neighbouring nations has been negotiated in Latin America, but the treaty establishing it is not yet in force. Other regional nuclear weapon-free zones were considered but the difficulties encountered in this creation led B. Feld, after the Madras Pugwash Conference, to present the draft of a treaty establishing a world wide nuclear weapon-free zone open to any country that is willing not to develop or to accept possession of nuclear weapons on its territories, and not to deploy or to permit deployment of nuclear weapons on its territories.

Similar approaches are inadequate in the case of Central Europe where a large number of nuclear weapons belonging to the United States or to the Soviet Union are already deployed in different countries. It would be important to improve this situation, which is very ominous, because Central Europe is the region where a major nuclear war very likely would begin.

Indeed, the withdrawal from all European countries of all nuclear

weapons not belonging to the country in which they are deployed was proposed and discussed in Pugwash Conferences several years ago. This proposal would have created a large nuclear weapon-free zone in Central Europe including the entire territories of Belgium, the Netherlands, West- and East Germany, Poland and Czecho-Slovakia. But no agreement could be reached on this proposal, essentially because it was far too unbalanced between the United States and the Soviet Union. It implied that all the American nuclear weapons deployed in Europe would have to be returned to the United States across the Atlantic Ocean, more than six thousand kilometres away from the border between the countries associated by the North Atlantic Treaty and those associated by the Warsaw Pact, whilst the nuclear weapons deployed in Central Europe by the Soviet Union would have to be withdrawn less than a thousand kilometres away from this border, just across the eastern border of Poland.

Considering the reason for this failure, I presented verbally, during the 1976 Pugwash Conference in Mühlhausen, at a meeting of Working Group 3, a less ambitious but seemingly more realistic proposal aimed at the creation of a rather narrow nuclear weapon-free zone extending on both sides of the border between West- and East Germany. This proposal was briefly mentioned in the report of Working Group 3 (§ 4) with the expression of the doubts of some members who considered that it would not increase security in Europe, and might be soon overtaken by the development of new technology.

These doubts on the importance of a limited nuclear weapon-free zone in Central Europe underestimate the serious risks involved in any deployment of tactical nuclear weapons, including mini nuclear weapons, close to the border between West- and East Germany, even if the use of such weapons requires a decision of the highest authority in Washington or in Moscow. It should be kept in mind that the battle units stationed near this very sensitive border would be immediately engaged in fierce fighting in case of a war started in this region, for instance by an attempt to change by force the status of Berlin. If then, on one side or the other, some of these units, endowed with nuclear weapons, were in a difficult situation, such as the threat of being surrounded, the commanding officers in charge might exert an irresistible pressure to obtain the authorisation of using their muclear weapons which might fall in the hands of the enemy. A nuclear escalation might thus start, as a result of a local setback, even of no great significance.

To avoid a nuclear war that might start without a deliberate decision of any of the parties involved in a conventional war, it appears thus very important that no military unit likely to be immediately engaged in first line fighting at the beginning of a war be endowed with nuclear weapons of any kind. But such a nuclear disarmament of the first line troops in Central Europe will be acceptable by both parties only if, in case of a nuclear attack on its troops by the other party, each party has the possibility to quickly support these troops by means of short or middle range nuclear weapons, which should thus be deployed not too far away from the probable initial fighting line. In such a case it should even be possible to bring back to the fighting troops short range nuclear weapons (transported, for instance, by helicopters).

It was the consideration of all these requirements which led to the proposal made last year of the establishment of a limited nuclear weapon-free zone in Central Europe. To have at first a simple and clear definition of such a zone, it was proposed that it might extend from the Rhine to the Vistula, covering a part of West Germany, the whole territory of East Germany, a part of Poland and of course Berlin. This nuclear weapon-free zone would not be exactly symmetrical with respect to the border line between West- and East Germany but would extend approximately at equal distances, some 500 km, west and east of Berlin. On its southern side, it should include a large part of Czecho-Slovakia (Bohemia and Moravia).

Such a nuclear weapon-free zone should be acceptable to the United States as well as to the Soviet Union, because the withdrawal from it of all nuclear weapons would have similar consequences for both, the American forces in Europe keeping the possibility of deploying their nuclear armament in Belgium, in the Netherlands and on the left bank of the Rhine in West Germany.

An objection to the proposed withdrawal of nuclear weapons from all the advanced positions in Central Europe is that it would lessen the deterrent effect of the nuclear armament deployed in Europe in face of a possible conventional attack. I don't think that this diminution of deterrence is sufficient to overbalance the great advantage resulting from the considered withdrawal, with a smaller probability of a nuclear war. Anyway this diminution of deterrence would be much smaller than that which would result from a "no first use agreement", and the United States might accept it even if they continue to refuse any no first use agreement.

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C. E. Osgood (USA) XXVII-20

GRIT FOR MBFR : A PROPOSAL FOR UNFREEZING FORCE-LEVEL POSTURES IN EUROPE [1]

The focus of my concern with international relations has been the rationalization of a strategy alternative whose technical name is Graduated and Reciprocated Initiatives in Tension-reduction -- GRIT, which is not only easy for people to remember but also suggests the kind of determination and patience required to successfully apply it.

GRIT is a strategy in which nation A devises patterns of small steps, well within its own limits of security, designed to reduce tensions and induce reciprocating steps from nation B. If such unilateral initiatives are persistently applied, and reciprocation is obtained, then the margin for risk-taking is widened and somewhat larger steps can be taken. Both sides, in effect, begin edging down the escalation ladder, and both are moving, within what they perceive as reasonable limits of national security, toward a political rather than a military resolution. GRIT is not a substitute for the more familiar process of negotiation, but rather a facilitative, parallel process designed to enable a nation to take the initiative in a situation where an unsatisfactory status quo has become frozen -- which is precisely the situation in Europe today as far as the confrontation of the military forces of East and West are concerned.

Over the past 15 years or so there has been considerable experimentation with the GRIT strategy -- but mostly in the laboratory. There have been sporadic GRIT-like moves in the real world -- for example, the graduated and reciprocated pull-back of U.S. and Soviet tanks, which were lined up practically snout-to-snout at the height of the Berlin Crisis -- but for the most part these have been one-shot affairs, always tentatively made, and never reflecting a genuine change in basic confrontation strategy.

The one exception to this dictum was The Kennedy Experiment, as documented in a significant paper of Amitai Etzioni by this title.

This real-world test of a strategy of calculated de-escalation was conducted in the period from June to November 1963. The first step was President Kennedy's speech at The American University on June 10, in which he outlined what he called "A Strategy of Peace", praised the Russians for their accomplishments, noted that "our problems are man-made . . . and can be solved by man", and he then announced the first unilateral initiative -- the United States was stopping all nuclear tests in the atmosphere and would not resume them unless another country did. Kennedy's speech was published in full in both Izvestia and Pravda, with a combined circulation of 10,000,000. On June 15, Premier Khruschev reciprocated with a speech welcoming the U.S. initiative, and he announced that he had ordered production of strategic bombers to be halted.

The next step was a symbolic reduction in the trade barriers between East and West; on October 9, President Kennedy approved the sale of $250 million worth of wheat to the Soviet Union. Although the U.S. had proposed a direct America-Russia communication link (the "hot line") in 1962, it wasn't until June 20, 1963 -- after the Kennedy Experiment had begun -- that the Soviets agreed to this measure. Conclusion of a test ban treaty, long stalled, was apparently the main goal of the experiment: multilateral negotiations began in earnest in July, and on August 5, 1963, the test ban treaty was signed. On November 22, 1963, the Kennedy Experiment came to an abrupt end -- in Dallas, Texas.

Had this real world experiment in calculated de-escalation been a success? To most of the initiatives taken by either side, the other reciprocated, and the reciprocations were roughly proportional in significance. What about psychological impact? I do not think that anyone who lived through that period will deny that there was a definite warming of American attitudes toward Russians, and the same is reported for Russian attitudes toward Americans -- they even coined their own name for the new strategy, "the policy of mutual example"!

Although by no means ideal or uncomplicated, the present status quo in Europe would appear to be generally favorable for successful application of GRIT strategy to unfreeze this force posture.

For one thing, there is a rough parity of military power between East and West in this region; both strategic and land-based tactical nuclear forces are sufficiently balanced for political deterrent purposes (although what the super-powers call "tactical" may be realistically perceived by Europeans as disastrously "strategic"), and according to a recent Brookings Institution report the quantitative balance in conventional forces ". . . is not so adverse to NATO as has often been claimed." For another thing, both the U.S. and the U.S.S.R. have powerful motives for reducing forces and tensions in Europe, as do the European NATO and Warsaw Pact countries, of course -- mutual need for reducing the cost of maintaining such large forces (estimated to be nearly $18 billion a year for the U.S.), mutual fear of conflict escalation to nuclear levels, mutual desire for increasing trade and technological exchanges, for example.

Both the European Security Conference (ESC) and the Mutual and Balanced Force Reduction negotiations (MBFR) are expressions of these motives. But all parties are well-aware of the complexities that will be encountered in such negotiations. Negotiated agreements require prior commitment from all parties before any can move at all; by substituting post commitment, via reciprocation, GRIT frees all parties for taking the initiative. To the extent that GRIT is successful, mutual trust is increased and negotiations can move faster. Now, with special reference to the European situation, I will try to spell out some of the "rules" by which the "game" of GRIT should be played -- so as to maintain national security during the process, to increase the likelihood of obtaining reciprocation, and to guarantee the genuineness of initiations and reciprocations.

Rules for Maintaining Security

Rule 1: Unilateral initiatives must not reduce one's capacity to inflict unacceptable nuclear retaliation should he be attacked at that level. Nuclear capacity can serve rational foreign policy (a) if it is viewed not only as a deterrent but also as a security base from which to take limited risks in the direction of reducing tensions, (b) if the retaliatory, second-strike nature of the capacity is made explicit, and (c) if only the minimum capacity required for effective deterrence is maintained and the arms race damped. Needless

to say, none of these "if" conditions have been met to date by the two nuclear superpowers. In the European theater, both strategic and tactical weapons are redundantly deployed and are in oversupply as far as capacity for graded response to aggression is concerned. Therefore, at some stage in the GRIT process, graduated and reciprocated reductions in nuclear weapons, along with the men that are assigned to them, should be initiated.

Rule 2: Unilateral initiatives must not cripple one's capacity to meet conventional aggression with appropriately graded responses using conventional weapons. Conventional forces are the front-line of deterrence and they must be maintained at rough parity in regions of confrontation. But the absolute level at which the balance is maintained is variable. The general rule would be to initiate unilateral moves in the regions of least tension and gradually extend them to what were originally the most tense regions. The Central region appears to be the best locus for initiating GRIT. In the heartland of Europe, especially in Germany, the balance between forces is in rough parity -- with the Pact ground forces closer at hand but the NATO forces more mobile. This suggests a two-stage withdrawal process for the U.S. and the U.S.S.R., with troops first removed to a location away from the heartland of Europe but near enough for quick return if required. Such a two-stage withdrawal process would also have the advantage of providing high visibility (i.e. verifiability) of both first-stage (arrivals from Central Europe) and second-stage (departures for the U.S.) initiatives. A similar procedure by the Soviet Union would offer like advantages.

Rule 3: Unilateral initiatives must be graduated in risk according to the degree of reciprocation obtained from an opponent. This is the self-regulating characteristic of GRIT that keeps the process within reasonable limits of security. If bona fide reciprocations of appropriate magnitude are obtained, the magnitude of subsequent steps can be increased; if not, then the process continues with a diversity of steps of about the same magnitude of risk. The relative risk remains roughly constant throughout the process.

The motives of the parties involved suggest the following basic design of GRIT moves: initiatives by one or the other of the superpowers in graduated withdrawal of their own forces, it being clearly

indicated that (a), if reciprocation by the other is obtained, there will be no replacement of such forces (i.e. an over-all reduction will have been accomplished), but (b), if there is no appropriate reciprocation in a reasonable period, then the equivalent of the withdrawn superpower forces will be supplied by its allies (other NATO or other Warsaw Pact members in the involved areas). Resultant (a) should be preferred to (b) by both sets of nations -- but even (b) would serve the interests of the superpowers by reducing their burden and the interests of all in de-focalizing the confrontation in Europe, thus enhancing the prospects for future de-escalation moves.

Rule 4: Unilateral initiatives should be diversified in nature, both as to sphere of action and as to geographical locus of application. The reason for diversification is two-fold: first, in maintaining security, diversification minimizes weakening one's position in any one sphere (e.g. combat troops) or any one geographical locus (e.g. Berlin); second, in inducing reciprocation, diversification keeps applying the pressure of initiatives having a common tension-reducing intent and (hopefully) effect, but does not "threaten" the opponent by pushing steadily in the same sphere or locus and thereby limiting his number of options in reciprocating. A gradual shift toward a multilateral initiation/reciprocation process would seem to have certain advantages; one would be depolarizing threat perceptions; another would be spreading the involvement, and hence sense of responsibility, through both NATO and Warsaw Pact countries; and yet another would be maximizing the appropriateness of initiators and recipients to the natures of the moves.

Rules for Inducing Reciprocation

Rule 5: Unilateral initiatives must be designed and communicated so as to emphasize a sincere intent to reduce tensions. Escalation and de-escalation strategies cannot be "mixed" in the sense that military men talk about the "optimum mix" of weapon systems. The reason is psychological: reactions to threats (aggressive impulses) are incompatible with reactions to promises (conciliatory impulses); each strategy thus destroys the credibility of the other. It is therefore essential that a complete shift in basic policy be clearly signaled at the beginning. The top leadership of the initiating

power must establish the right atmosphere -- as Kennedy did -- by stating the over-all nature of the new policy and by emphasizing its tension-reducing intent. Early initiatives must be clearly perceived as tension-reducing by the opponents in conflict situations, must be of such significance that they cannot be easily discounted as "propaganda," and they must be readily verifiable -- but they should not be unstabilizing to the existing military status quo or readily invite an attempt to take advantage. And it must be kept in mind, to avoid "self-sabotage", that all of one government's actions with respect to another have the function of communicating intent. The moral here, of course, is that control over de-escalation strategies must be just as tight and pervasive as control over war-waging strategies, if actions implying incompatible intents are not to intrude and disrupt the process.

Rule 6: Unilateral initiatives should be publicly announced at some reasonable interval prior to their execution and identified as part of a deliberate policy of reducing tensions. Prior announcements minimize the potentially unstabilizing effects of unilateral acts, and their identification with total GRIT strategy helps shape the opponent's interpretation of them. However, the GRIT process cannot begin with a large, precipitate and potentially unstabilizing unilateral action. It is this characteristic of Senator Mansfield's (May, 1971) proposed amendment -- to cut by about half the U.S. forces permanently stationed in Europe in one fell swoop -- that would be most likely to produce destabilization in NATO/Pact relations, be threatening to our allies, possibly encourage Soviet politico-military probes, and decrease the chances of successful MBFR negotiations.

Rule 7: Unilateral initiatives should include in their announcement explicit invitation to reciprocation in some form. The purpose of this "rule" is to increase pressure on an opponent, by making it clear that reciprocation of appropriate form and magnitude is essential to the momentum of GRIT, and to bring to bear pressures of world opinion. However, exactly specifying the form or magnitude of reciprocation has several drawbacks: having the tone of a demand rather than an invitation, it carries an implied threat of retaliation if the demand is not met; furthermore, the specific reciprocation requested may be based on faulty perceptions of the other's situation,

and this may be the reason for failure to get reciprocation. It is the occurrence of reciprocation in any form, yet having the same tension-reducing intent, that is critical. Again speaking psychologically, the greatest conciliatory impact upon an opponent in a conflict situation is produced by his own, voluntary act of reciprocating. This is because this behavior is incompatible with his beliefs about the unalterable hostility and aggressiveness of the initiator. And once he has committed a reciprocating action, all of the cognitive pressure is upon modifying these beliefs.

Rules for Demonstrating the Genuineness of Initiatives and Reciprocations

Rule 8: Unilateral initiatives that have been announced must be executed on schedule regardless of any prior commitments to reciprocate by the opponent. This is the best indication of the firmness and bonafideness of one's own intent to reduce tensions. The control over what and how much is committed is the graduated nature of the process; at the time-point when each initiative is announced, the calculation has been made in terms of prior reciprocation history that this step can be taken within reasonable limits of security. Failure to execute an announced step, however, would be a clear sign of ambivalence in intent. This is particularly important in the early stages, when announced initiatives are liable to the charge of "propaganda".

Rule 9: Unilateral initiatives should be continued over a considerable period, regardless of the degree or even absence of reciprocation. Like the steady pounding on a nail, pressure toward reciprocating builds up as announced act follows announced act of a tension-reducing nature, even though the individual acts may be small in magnitude. It is this characteristic of GRIT which at once justifies the use of the acronym and raises the hackles of most military men. But the essence of this strategy is the calculated manipulation of the intent component of the perceived-threat-equals-capability-times-intent equation. It is always difficult to "read" the intentions of an opponent in a conflict situation, and they are usually very complex. In such a situation, GRIT can be applied to consistently encourage conciliatory intents and interpretations at the expense of aggressive ones.

Rule 10: Unilateral initiatives must be as unambiguous and as susceptible to verification as possible. Although actions do speak louder than words, even overt deeds are liable to misinterpretation. Inviting opponent verification via direct, on-the-spot observation or via indirect media observation (e.g. televising the act in question), along with requested reciprocation in the verification of his actions, is ideal -- and what little might be lost in the way of secrecy by both sides might be more than made up in a reduced need for secrecy on both sides. However, both the U.S. and the U.S.S.R. have long exhibited intense suspicion of each other and placed a heavy emphasis upon secrecy. This poses serious questions for the criteria for unambiguousness of unilateral initiatives and verifiability of reciprocations. The strategy of GRIT can be directly applied to this problem: particularly in the early stages, when the risk potentials are small, observers could be publicly invited to guarantee the verifiability of doing what was announced -- and this should be without explicit insistence on reciprocation in this respect, although the implication would be strong, indeed. Initiatives whose face-validity is very high should be designed -- for example, initial pull-backs of forces from border confrontations (analogous to the tank pull-backs mentioned earlier). The point I am trying to make is that the "policy of mutual example" can operate to gradually reduce suspicions and resistances to verification -- and this should accelerate as the GRIT process continues.

* * * *

The novelty of GRIT raises shrieks of incredulity from Hawks and clucks of worry even from Doves. Here are some of the questions I am most often asked.

Question 1: What reason do you have to believe that your "rules" -- which you admit are anchored in individual behavior -- would apply to the "behavior" of nations? The critical point here is that the decision-making of nations is a distillation of the thinking of individual human minds, and GRIT is designed to influence how individuals in nations think about other nations. People do tend to think about nations in human terms -- i.e. tend to personify them

-- and this includes statesmen and political scientists, as even casual reading of the literature on international relations will testify. It therefore seems reasonable to apply the principles of interpersonal behavior to international behavior -- and by so doing, try to influence the latter by operating on the former.

Question 2: Wouldn't any conciliatory gestures on our part destroy the credibility of our resolve and invite further aggression? The usually unquestioned assumption being made here is that the opponent shares our own perception of ourselves as being peaceful in intent, and therefore his blustering words, his military build-ups, and so on must be based on aggressiveness rather than on fear. How can THEY be afraid of peaceful, benignly-intentioned US? From such reasoning it follows that we must maintain a threatening image ourselves, lest we be taken advantage of. But there are two ways of creating and preserving credibility: maintaining a stance of implacable hostility is one way; maintaining a stance of firmness but potential cooperation is another way.

Question 3: Doesn't GRIT strategy require that good will already exist between the parties in conflict if it is to succeed? Not at all. What is required is sufficient self-interest on both sides. I have tried to demonstrate that in the European situation there exist both shared and unique motivations toward reducing military forces for all parties. If opponents in a conflict situation can be induced, because of their own self-interest, to keep on behaving as if they believed and trusted each other, then a general psychological principle of congruence between acting and believing will cause their beliefs to fall in line with their acts. In other words, mutual good will can literally be created in the service of mutual self-interest.

Question 4: Doesn't any novel approach like this involve too much risk? Anything we do in the nuclear age means taking risks. Escalating conflicts which involve another nuclear power unquestionably carries the greatest risk. Simply doing nothing -- remaining frozen in a status quo that is already at much too high a level of force and tension -- is certainly not without risk over the long run. GRIT also involves risk. But the risking comes in small packages.

* * * *

The European Security Conference and the negotiations on Mutual and Balanced Force Reductions represent prime opportunities for the two nuclear superpowers to reduce the tensions that exist between them. I have outlined a strategy which, by operating directly on the perceived levels of mutual threat in a calculated fashion, may make it possible to reduce perceived threats and thereby facilitate these negotiations. Looked at in broader perspective, the European confrontation has many positive elements in it, many motivations on all sides that favor détente, and it therefore offers itself as a potential proving ground for a strategy that is novel but yet appropriate to the nuclear age in which we are trying to survive. The assumption behind mutual nuclear deterrence -- that we can go spinning forever into eternity, poised for mutual annihilation and kept from it only by fragile bonds of mutual fear -- is untenable. The ultimate goal must be to get out from under the nuclear Sword of Damocles by eliminating such weapons from the human scene.

Footnote (from p.1):

[1]This is a summary of a paper by the same title. Requests for the full version should be addressed to:

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27th Pugwash Conference
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P. Noel-Baker (U.K.) XXVII-21

SUGGESTIONS FOR THE WORK OF THE PREPARATORY COMMISSION FOR THE SPECIAL SESSION OF THE UN GENERAL ASSEMBLY DEVOTED TO DISARMAMENT

If the Special Session is to lead to practical results the Preparatory Commission should urge the following points on the Governments of all Members of the UN:

1. To free the Special Session from the pressures of the arms race, there should be a "freeze" of military expenditure at present levels with the least possible delay.

   The Preparatory Commission should propose that the 32nd General Assembly (September 1977) should call on all Governments to pledge themselves to this freeze.

   A freeze would not be accepted as a long-term measure; but, if adopted by the 32nd General Assembly, it would be a pledge that the Governments were seriously intending to disarm at a relatively early date.

2. Representatives at the Special Session should be Ministers holding offices of the highest political responsibility.

   Disarmament concerns national defence and the avoidance of war. Prime Ministers, Foreign Ministers and Ministers of Finance have no other work of comparable importance. They should make it their Priority Number One, and give it all the time and effort needed.

3. The Governments should consider whether the Disarmament Treaty and securing its signature and ratification should not be left to the General Assembly itself in a series of Special Sessions.

   The great advantages of this plan are self-evident. Among others, it might bury a quarrel between China and the Soviet Union about a World Conference.

   A recommendation could appropriately be made to the 32nd General Assembly by the Preparatory Commission.

4. The Preparatory Commission should suggest no time limit for the duration of the Special Session. The Special Session should last as long as it is doing useful work.

5. Similarly, the Preparatory Commission should propose that the financial provision for the Special Session proposed by the Secretary-General ($ 208,000) should be supplemented by an agreement that all the money required for the Special Session should be provided, no matter how much it may exceed t h e Secretary General's estimate.

6. All the proceedings of the Preparatory Commission, of the Special Session and of their sub-committees and even their drafting committees, should be held in open session with the press present. It is meeting in private (not "secret" for all secrets are always leaked) that gives hawks, militarists and bureaucrats their power to obstruct.

7. In view of the long history of unsuccessful negotiations, many delegates of the UN certainly feel that negotiating and carrying out disarmament will inevitably be a long process, perhaps requiring many years.

This view should be resisted.

If disarmament is to be carried through within a measurable time, then the arguments for the earliest possible start are overwhelming:

i. If the forces are to be disbanded and the weapons scrapped within 10, 15 or 20 years;

and if, in that interval, it is vitally important that they should never be used in war,

it follows inexorably in logic that every dollar spent on them is pure waste - it is thrown away on armaments which will soon be scrapped, and which must never be used till the scrapping occurs.

ii. When disarmament comes, in 10 or 20 years it will bring great benefits: lower taxation, more money for housing, education, national health, abolishing world poverty.

If these benefits will accrue in 10 years' time, why not <u>now</u>, when they are very urgently required.

iii. While the nuclear stockpiles exist, there is the danger of holocaust by "accident, madness or miscalculation" (J.F. Kennedy). The sooner they are abolished, the sooner true national security will return.

8. Moreover, there is no reason why the drafting of a World Disarmament Treaty should require a very long time.

If it undertook the task, the Special Session would not start from scratch. There have been International Commissions and Conferences on Disarmament since the League of Nations began the work more than half a century ago.

These Commissions and Conferences only achieved some "partial" measures of disarmament, but they did solve all the technical and drafting problems involved of drawing up a World Disarmament Treaty.

They left models which the Preparatory Commission should submit to the Special Session:

i. President J.F. Kennedy's Draft Treaty of General and Complete Disarmament under effective international control, dated April 1962.

ii. The Soviet Draft Treaty with the same title, dated March 16, 1962.

iii. Two speeches made by Sir Alec Douglas Home in the Committee of Eighteen, March 1962.

iv. Declaration adopted by the Commonwealth Prime Ministers, March 1961.

v. President Herbert Hoover's Disarmament plan laid before the Geneva Disarmament Conference, June 1932.

vi. Plans drawn up by the Geneva Conference in 1932 regarding:

a. proposals for a system of reducing limiting manpower in the Armed Forces and Trained Reserves (conscripts and long-term volunteers).

b. Reduction and Limitation of Military Budgets.

c. Reduction and Limitation of Small Arms and Ammunition.

d. Reports on the Abolition of weapons that assist attack against defence ("offensive weapons").

e. Washington and London Naval Treaties of 1922 and 1930.

f. Part V of the Treaty of Versailles 1919 which disarmed Germany.

9. The Preparatory Commission should propose to the Special Session that a substantial part of the national expenditure saved by the Powers signatory to the Disarmament Treaty should be re-allocated to the Development of Third World Countries.

This is an essential part of disarmament policy, recognized to be so by many Resolutions of the UN General Assembly.

World Poverty is already the cause of very serious international friction, of serious divisions within the UN, and of armament expenditure by Third World Governments, who dream that they can enforce their "economic rights" by military power.

The re-allocation of resources is desirable to ensure world-wide support for Disarmament, and whole-hearted popular acceptance of the Treaty.

10. The Preparatory Commission should make proposals for the adequate participation of Non-Governmental Organizations (NGOs) in their own work and in the work of the Special Session. (The World Federation of UNAs, the Churches, Trade Unions, International Co-operative Alliance, Women's Movements, etc.).

They should propose:

i. that an opening day of their own first session, and of the Special Session, should be given to hearing the spokesmen of the NGOs;

ii. that these spokesmen should be given seats in the meetings of the Commission and the Special Session where they can follow the proceedings at close quarters;

iii. that they should have the right to circulate documents to the Delegates;

iv. that they should have the right to speak, if the President of the Commission and of the Special Session give permission.

11. In recent years, many people concerned with Disarmament have consciously or sub-consciously accepted the principle that "small is easy".

But Jules Moch (Prime Minister and Minister of Defence of France) pointed out long ago that in practice this was not true: "A limited agreement seems to me today to be as difficult to reach as a general agreement". (UN Sub-Committee, April 23, 1956).

On April 24, 1952, President Truman's delegate, Mr Ben Cohen, defined the purpose of Disarmament negotiations as follows:

i. "The goal of Disarmament is not to regulate, but to prevent war ..... by making war inherently, as it is constitutionally under the Charter, impossible as a means of settling disputes.

ii. "To achieve this goal, all states must co-operate in establishing an open and substantially disarmed world

a. in which armed forces and armaments will be reduced to such a point and in such a thorough fashion that no state will be in a condition of armed preparedness to start a war."

As Mr Cohen pointed out, and as is self-evident, the further Disarmament is carried towards this goal, the fewer and simpler will be the technical difficulties encountered, the easier the problem of inspection, and the less the risk that any Government will try to cheat.

"Small is easy" is a basic fallacy. Moreover, small measures cannot by their nature evoke the wide-spread popular support without which Disarmament will never succeed.

This document has been specially prepared by Dr. Wionczek as convener of Working Group 5. It is intended to serve as a basis for discussion by the Working Group in Munich, and for working papers submitted by participants. The latter should not exceed 10 double-spaced typewritten pages, plus a 250 word abstract for possible publication in the Pugwash Newsletter.

27th Pugwash Conference

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M.S. Wionczek (Mexico) XXVII-22

PUGWASH AND THE FORTHCOMING WORLD CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

At the risk of being accused of extreme intellectual arrogance, let me start with the transcription of my editorial on the subject of World Conference on Science and Technology for Development, published in Science last May:

> More than 2 years after the U.N. decision to convoke a World Conference on Science and Technology for Development in 1979, and less than 2 years before it actually takes place, our understanding of the links between science and technology and -- the development needs of the Third World is still very slim.
>
> In the advanced countries the position seems to prevail that fostering science and technology - for development amounts to establishing modern scientific institutions in less developed countries - (LDCs) and massively transferring modern technology to them, preferably through private channels. - On the other hand, many spokesmen for the underdeveloped world understand science and technology for development as abolishing all international barriers that hinder their access to the fruits of scientific and technological progress. It is highly - - doubtful that either of these two extreme positions offers a solution to the problems of LDCs. Scientific institutes, massive transfers, and tearing down the barriers to the flow of knowledge will hardly - do the trick because the capacity of the poor world to absorb and to use scientific knowledge and technical know-how in a meaningful way is very weak.
>
> What the underdeveloped countries need first and foremost is the buildup of their internal scientific and technological capacity. The achievement of such an objective will depend more and a long-term integrated international and domestic effort than on piecemeal initiatives guided by ideological preferences or by magic thinking. This rather simple proposition seems to be forgotten by many, if not most, diplomats, scientists, and international bu-

reaucrats participating in the preparatory stages of the U.N. Conference on Science and Technology. At least this is the impression one has after the most recent meeting of the U.N. Committee on Science and Technology for Development (New York, February 1977).

One of the major obstacles to the advancement of science and technology in the underdeveloped world originates from the divorce between local R&D activities and the educational and productive system and from the lack of general scientific and technological culture. Consequently, whatever knowledge is produced domestically is used neither to improve the quality of education nor for productive purposes. Moreover, the supply of internally produced scientific -- knowledge and technical know-how does not automatically create a demand, because the little demand that exists is historically directed to the outside world.

Thus, the advancement of science and technology in the poor countries will depend more on establishing permanent and strong links between the R&D system, education, and the economy than on the volume of imported knowledge and an increased allocation of human and financial resources for research institutions. In the absence of domestic demand for their output, a corollary to the absence of scientific culture, modern scientific institutes set up in the LDCs with help from outside wither away or become sources for brain drain. On the other hand, dependence on massive imports of technology through traditional channels leads to the emergence of advanced technology enclaves that perpetuate themselves in the context of general technological backwardness.

Unfortunately, while scientific communities in the advanced countries know very little about the nature of underdevelopment, the links of most diplomats and bureaucrats from the poor world with their own societies are very often incidental. Given that scientific and technological policy for the development of the LDCs must be put in the framework of the overall development policy and must build bridges between R&D and the educational and productive systems, the U.N. Conference and Science and Technology for Development, manned mostly by scientists from the North and diplomats from the South, will be facing the most serious handicaps.

Many people will react to this gloomy presentation of the prospects for the U.N. -sponsored World Conference by - pointing out that it is not going to be either the first or the last global jamboree of little relevance. Others will say that considering the magnitude of financial resources - wasted world-wide on not only highly irrelevant but also deeply harmful things such as armaments, spending every 10-15 years $20 million dollars on a science and technology Babel tower-kind of assembly is a trifling matter.°°

I would take the position that we can hardly afford - anymore global jamborees or Babel-tower assemblies on science and technology not because they represent waste of time, human energy and money, but because the gap in respect to - the scientific and technological performance of the DCs and the LDCs grows so fast, that it is becoming unmanagable and breeds increasing internal and international conflicts. Fortunately, since we are still two years away from World Conference, we could do something about it. If well thought - out and reasonably well managed, the Conference could offer a - very much needed chance to all the parties concerned for - - arriving at some sort of general consensus about the preconditions for building science and technology for development

°°The U.N. budget for the World Conference itself is of order of $12 million according to preliminary estimates.

and for making international scientific and technological co-operation work better than in the recent past. If such a goal were achieved instead of the meeting degenerating into the sterile political confrontation, the Conference might represent an important contribution to the decent future of those two-thirds of the humanity who in the era of intercontinental missiles and interplanetary expeditions cannot see their basic biological and human needs satisfied.

The job is not at all easy not only because both DCs and LDCs seem to be paralyzed by short-term political considerations but also -what is more important- because scientific and technological underdevelopment of the LDCs is the part and parcel of their overall underdevelopment. In respect to science and technology this means that while most power holders in the LDCs have very primitive notion of science and technology and of its societal role, LDC scientific communities are as the rule tiny mediocre copies of their counterparts in the advanced world, and LDC technological elites are largely under-educated and deficiently organized. All this would be fine and dandy as far as the DCs are concerned, if a small complication would not have been taking place in the LDCs: most members of these societies are suc-

cumbing to all sorts of frustrations because of their constant exposure to the image of wealth and welfare reached in the advanced countries and due largely -the poor are told day in and day out- to scientific and technological progress achieved by the rich societies.

In some recents attempts to formulate and implement - scientific and technological policy programs in several larger LDCs, like India and Mexico, one finds a lot of useful -- insights into the problems of scientific and technological - underdevelopment. While their major discovery may sound very trivial to many of Pugwash members from the advanced - - countries, it is worth to be recalled: If a society wants - to have socially relevant science and technology and if it - wants to use the acquired knowledge and know-how for satisfying these needs, the society in question must have a minimal - capacity to define them with some clarity. Once these needs are defined (and they cannot be defined from outside), the - society will have to undertake a major and manyfold task of improving the general quality of human resources, establishing educational systems worthy of that name, modernizing managerial elites -both private and public, and assuring -hopefully through democratic means- that political power will not -

stay permanently in hands of primitive and unscrupulous politicians, whether civilian or military. In brief, the job of organizing science and technology for development (and this is presumably what the World Conference is about) is not the question of money, haphazard institutions building or external assistance. It is the question first and foremost of internal social transformation involving a long and strenuous domestic effort that will give results only in the long-run.

Since, however, the underdeveloped societies' basic needs which cannot be satisfied without scientific and technological inputs, are not only urgent but are perceived as urgent by the growing number of people, the LDCs need lots of help from outside. Such help will be, however, mostly useless if it takes the form of strictly scientific and technological cooperation. Since there cannot be science and technology worthy of that name in a social vacuum and under repressive political conditions, science and technology cooperation must be linked with the goal of accelerating social transformation in the LDCs. To sustain that international scientific and technological cooperation or assistance is neutral amounts to propagating dishonest myths. Ac-

cording to its content, cooperation may either retard - or help social transformation.

The job of building up science and technology for development is doubly difficult. First, the present scientific and technological backwardness of the most LDCs is much greater and deeper than the backwardness that characterized in their pre-socialist times relatively recent entrants in the mainstream of science and technology progress -the socialist countries. - Contrary to many beliefs, based upon ignorance or prejudice, the Soviet Union before 1917, Poland and Hungary before 1945 and China before 1948 were quite advanced in all possible respects -including science and technology- in comparison with most of Latin America, Africa and Asia of the present day. Among other things, their elites had scientific and technological culture and tradition, two important ingredients of -- science and technology progress badly missing in most LDCs.

The second difficulty arises from the absence of social - transformation in the underdeveloped world. We all know - - that scientific and technological progress achieved in the - advanced countries over the past 200 years followed and not

preceeded social transformation. While obviously scientific and technological progress of the XIX century Europe and the United States had its impact upon the direction of social -- transformation, only in the past 50 years the sheer magnitude and weight of science and technology became the decisive factor in that transformation. In most of the LDCs social and political conditions are very much different from - those in the today's advanced countries -whether West or - - East- 100 or 50 years ago. Social transformation is not only largely absent but attempts to promote it are suppressed. Only a boundless optimist can detect positive social transformation today in the poorest part of the globe -South Asia, in the richest- the Middle East, or in the perhaps neither too poor not too rich -Latin America, overwhelmed presently by military dictatorships.

Organizers of the World Conference -scientists from the -- DCs and diplomats and low-level burasucrats from LDCs-achieved somehow a considerable feat of leaving basic issues: the - LDC absolute and relative scientific and technological backwardness and the absence of social transformation -out of the agenda of the meeting. Instead the Conference is expected to offer the global overview of the progress of science and technolo

gy in the LDCs and to discuss (presumably external) obstacles to its flourishment.

Time-consuming and costly mechanisms are being set up to elaborate national papers that are supposed to evaluate the LDC science and technology progress in some 100-odd countries and offer ideas about future policies and actions in the same field on national, regional and international level. The wisdom contained in these papers is expected to be distilled by regional U.N. commissions and other offsprings of the rapidly growing U.N. family to be discussed jointly at the final stage by profound and eminent persons that will lead respective official delegations to the global Conference.

I can hardly wait to read papers on scientific and technological progress and policies of Honduras, Paraguay, Ecuador, Senegal, Gabon, Zaire, Bangladesh, Nepal and Afghanistan, written by local wise men. Speaking about the part of the world I know better, I am even more curious to learn -from official domestic sources- about the progress in the same field in such countries as Argentina, Uruguay or Chile, where in the most recent years conscient and well organized efforts were made by

patriotic thugs to destroy -for political reasons- local scientific and technological communities, efforts that resulted in the mass exodus abroad of the best human resources available in these countries.

Speaking more seriously, the question arises what non-governmental groups of scientists and technologists with -- high international reputation and proven moral solvency -such as Pugwash, can do in respect to the gloomy prospects for the World Conference on Science and Technology for Development. One alternative would be to forget the whole thing and continue cultivating nos propres jardins. Another, perhaps more decent, is to establish contacts with other similar groups also preoccupied with the preparations to that Conference, - for the purpose of exerting joint pressure over its organizers. The pressure would aim at dedicating at least a part of the 1979 jamboree for the discussion of real issues and not only for presentation of self-congratulating official reports followed by accusations directed towards all sorts of the enemies of the LDCs (by the widely accepted definition the enemies are as the rule domiciled abroad).

All these real issues are related either to internal

causes of the present scientific and technological backwardness of the most LDCs (the absence of social transformation) or to the inadequate conceptual framework of traditional international cooperation in the same field. Some of the major issues are related to both subjects.

The topics are plenty and few of them have appeared in the almost completely forgotten by now declaration on International Cooperation for Development, approved by consensus at the special session of the U.N. General Assembly, held in September 1975. The more complete but not all inclusive, by any means, list of major topics might cover the following - - questions:

1. What sort of local social and political conditions are necessary for building science and technology in - the LDCs.

2. What kind of educational systems may make the job of building science and technology in the LDCs not only possible but socially useful.

3. Can science and technology be meaningfully developed

in the LDCs without participation of the productive - systems.

4. What purpose, if any, serve the mushrooming national science and technology councils in the LDCs in face of the backwardness of political structures.

5. What characteristics should have national science and technology plans not limited to purely decorative exercise.

6. What kind of technology transfer the LDCs really need and what makes the difference between real and - spurious transfer.

7. In what sort of institution building in the science and technology sector should the LDCs engage without running the risk of bureaucratizing and finally killing the tiny existing scientific and technological systems.

8. Who is responsible for the growing brain drain - - from the LDCs -just rich imperialists abroad or power-holding thugs at home.

This list is suggestive of many useful exercises of the symposium type that Pugwash together with others might sponsor between its Munich and Varna 1978 Conferences for the purpose of bringing their findings to the attention of the organizers of World Conference hopefully before the whole ship - sinks. The next step would be to dedicate one day of the Munich Assembly for discussion among those Pugwashites, whose hearts are not closed to the problems of the underdeveloped world, of mechanics of such an emergency action program aimed at saving World Conference for Science and Technology from - the premature and perhaps not totally deserved death and - - oblivion.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

C. Djerassi (USA) XXVII-23

HUNGRY PEOPLE - HUNGRY PESTS

It is no surprise that "population" and "food" are two topics high on this Pugwash Conference's agenda. Indeed, any discussion of world affairs must directly or indirectly deal with population and food - two subjects that are intimately related. The urgency of food shortages reaches regional or global importance only when large numbers of people suffer; if there is one feature of the next quarter century that can be guaranteed, it is excessive population coupled with pressing food requirements. It is generally agreed[1] that cultivating virgin land with new food crops - aside from isolated areas such as Brazil - is not a global answer for the simple reason that we have basically run out of arable land. We are reduced, therefore, to increasing food production through more indirect means using presently available land and I would like to address myself to one such indirect approach.

"Each year an estimated half of the world's critically short food supply is consumed or destroyed by insects, molds, rodents, birds and other pests that attack foodstuffs in fields, during shipment and in storage."[2] In theory, prevention of such destruction offers one of the most immediate and simple ways to increase the available food supply, and a major portion of this solution is of a technological character. One such step is improved pest control - whether one is talking of insect pests, rodents or competitive weeds - and over the short run chemical

insect, rodent or weed control is likely to produce the most visible results. I emphasize the words over the short run, because such emphasis on relatively short time frames (e.g. a decade or two), though understandable on political and even humanitarian grounds, carries with it a price that is associated with the longer term environmental consequences of such increasing dependence on chemical solutions. When dealing with technological matters, the molders of world public opinion are by and large the citizens of the technologically most advanced (and ipso facto richest) countries in the world, whose perception of problems and priorities is frequently myopic and parochial - the attitude towards health care being a typical example. It is crystal clear that hundreds of millions of people suffer from parasitic and tropical diseases, but since these people live almost exclusively outside the northern belt of global affluence, virtually no resources are allocated to the solution of these health problems as compared to cancer or cardiovascular diseases. On a global scale, these diseases affect much smaller numbers of predominantly older people, who, however, happen to live in the most highly developed countries. This dilemma of greatly differing perception of priorities between the rich and the poor is even more striking in the context of pest control (and hence increased food production) and yet is almost totally ignored. The usual professional background of Pugwash participants would suggest virtual unawareness of this problem, but if this 27th Pugwash Conference is concerned enough to include population and food problems among its agenda, a brief airing of this particular "risk-benefit" problem is indispensable.

Pest control, be it chemical or biological, is practiced in only two areas, namely agriculture (including food storage) and public health.

The present public opinion climate in the affluent countries considers everything "chemical" to be synonymous with "unnatural" and therefore intrinsically undesirable, while "biological" is generally equated with "natural" and therefore acceptable. This grossly simplistic value judg - ment also applies to pest control and it is generally assumed that "biological pest control" is desirable, whereas "chemical pest control" is invariably harmful. As usual, grey problems do not yield to black and white answers: Pest control of any type upsets the ecological balance, as indeed does man's presence on this earth, and it is the judicious use of various methods that needs to be evaluated. It is not difficult to create a horror scenario based on the indiscriminate use of some biological control method, just as we are well familiar with environmental and health disasters associated with the deliberate or inadvertent misuse of chemical approaches.

The particular geo-economic setting enormously affects the use pattern and indeed the overall attitude towards pesticides. Thus in recent years, it has been primarily people high on the socio-economic-cultural ladder who have started to pay more attention to the inherent drawbacks rather than the potential benefits of any chemical agent, be it a pesticide, drug, food additive or the like. We should recognize that for the next decade or two the chief criterion will be "safety" rather than "efficacy". This, per se, is neither undesirable nor unreasonable, given the headlong and even precipitous technological advances of the last quarter century and the necessity for reflection and digestion. What is not desirable or even reasonable is to assume that "safety" and "efficacy" are absolute terms or to apply them with equal rigor and inflexibility irrespective of the importance of the problem. We have a tendency to totally ignore the cost (even more social

than economic) of time. Thus, the world is currently adding one billion people every decade and a technological solution (assuming that one could be created) dealing with the population problem clearly carries with it an enormously expensive time component, since every year of delay "costs" the equivalent of many millions of people. How are these general comments dealing with attitudinal perceptions pertinent to the pest control question?

Pest control is only practiced where there are people and as noted above this practice focuses primarily on public health and agriculture. Taking the former area first, unsolved public health problems are at the present time clearly much more significant in the Third World than in the affluent (and therefore largely northern) countries and are frequently associated with the insects and related pests that thrive in the more tropical countries. Currently, a substantial amount of lip service is being paid to the need for the control of diseases such as malaria, onchocerciasis ("river blindness") and bilharzia. Yet in actual fact, the affluent part of the world is really unwilling to pay much for the control of these pests - either in terms of money or, even more importantly, in terms of technological resource allocation - and the poorer countries simply cannot afford either one. Ironically, in the affluent areas of the world, the public health aspects of pest control are frequently dominated by recreational or even aesthetic considerations to the extent that a few flies or mosquitoes in an affluent suburban home can become the targets of substantial financial expenditure and absurd overkill. On a "per insect" basis, the allocations of resources are grotesquely skewed when one compares the wealthy and the poor.

More relevant to the world food problem are the agricultural applications of pest control, whether they occur during the production or

storage phase. These applications range from intense, expensive, preventive pesticide usage in the high technology agriculture regions (nearly 50 % of the world's pesticide production is consumed in the USA, 25 % by Western Europe and 12 % by Japan!) to desperate and insufficient use for survival in one-crop agricultural countries. The former are the sites of economic and technological wealth, where all new developments and most primary manufacture of pesticides occur, but they are also the countries where the greatest concern is expressed (primarily by the non-user public) about environmental effects. The Third World countries (with the striking exception of the People's Republic of China) are totally dependent on the highly developed countries for present and future pesticides, but their own priorities or concerns are rarely taken into consideration for obvious economic reasons. One of these reasons is that virtually all important past and present developments in the pesticide field emanate from private industry (with its overriding profit motivation) in the highly developed Western countries, where historically and operationally there exists no public sector counterpart to undertake that development function if private industry were suddenly to withdraw from that field. In fact, some withdrawal has already occurred during the past decade in that some large, diversified industrial concerns have dropped out of the pesticide area for economic reasons (to take the largest one - Exxon - as just one striking example), while hardly any new-comers have had the courage or motivation to enter it. A key reason for the greatly reduced attractiveness of this field to the technological innovator has been the enormous impact in the USA, Germany, Japan, Holland, etc. of government regulatory agencies, who not only decide upon the ultimate admission of a new product into the commercial market, but who frequently also control completely the ex-

perimental (large scale field trial) phase of such work. As was pointed out recently[3], development times for new and environmentally more appropriate pest control agents are starting to approach the ten year period. The economic risk associated with such long term research is such that only primary applications to very large crops (principally corn, cotton, soya beans and wheat) in high volume user countries (i.e. USA) will justify the financial, human and intellectual expenditures required to generate a new pest control agent in the present social climate. This climate is predominantly created by the "non-user" environmentalist (living in the most advanced countries) who generally bases his conclusions on potential long term consequences with hardly any consideration for short term economic penalties. (When the existence of such economic penalties is realized, it is always assumed that these will be borne by industry.) The user (whether he lives in a highly developed or in an underdeveloped country) on the other hand, concentrates almost exclusively on economic costs at the expense of potential long term hazards.

From a longer term (i.e. quasi-historical) standpoint, these conflicting priorities are not necessarily bad, since stresses of this type frequently result in desirable, long term changes in society. Unfortunately, these diverging priorities coincide with a major, world-wide food shortage, which is unlikely to subside for decades.[1] For reasons pointed out in the beginning of the paper, almost the only short term answer to the problem involves significant reduction in food and agricultureal losses and spoilage.[4] This will require global rather than parochial outlooks by government planners and agencies; it demands decisions that must be made within relatively short time frames. Unfortunately, both of these

requirements are the antithesis of the modus operandi of government agencies or of world-wide agencies such as F.A.O. Even if we accept development times of a decade or more for the development of fundamentally new pest control agents - be they chemical or biological in nature - incentives of primarily an operational rather than just financial nature will need to be offered, which neither government agencies nor the general public in the highly developed countries may find too palatable.

Pugwash, with its representation from North and South, East and West, may be a possible forum at which a listing of such incentives may be attempted - incentives which will take into consideration not only the realistic short term objectives of many Third World Countries, but the equally realistic short and medium term economic objectives of those technological sectors of the highly developed countries who are the only ones currently capable of significant innovative new approaches to pest control. How to weave this into a fabric that can be worn by a constituency encompassing the wide range from economically preoccupied user to visionary environmentalist with his long term perspective is a troubling question. It would be a pity - and the eventual price a high one - if no solution can be devised.

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27th Pugwash Conference

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Rita R. Rogers (USA)

XXVII-24

DECREASING TENSION AND MISTRUST AMONG NATIONS

The first thing to be said about tension and mistrust among nations is that they are inevitable, given the human condition. The second is that a concentrated effort toward decreasing distrust is imperative; it should be given the same importance as the prevention, treatment, and dimunition of disease. The third is that in the international arena an appeal to rationality is nearly useless, since nations are composed of people and people are composed of emotions, both individual and shared. To search for rational causes of conflict is to deny emotional ones: The possibility of conflict decreases as the decision maker acknowledges his own feelings, attempts to understand those of his counterparts in other countries, and tries to shape his policy--and the expression of it--with both in mind.

I should like to explore some of the psychological aspects of international politics, but first, something should be said about the curious, shifting nature of world affairs. The overriding theme, of course, is anxiety about one's enemies, especially as symbolized by the possession of awesome weaponry, itself an expression of fierce mistrust. We have lived three decades with the possibilities of destruction, and in the face of that hard reality, the necessity of understanding the changing mass perceptions of one's own and other nations assumes great significance.

Let's examine for a moment of good example of shifting defenses and perceptions. It is offered by Steve R. Pieczenik, MD,in an article called, "Foreign Policy, Ego-Defense Mechanisms, and Bālance-of-Power Vulnerability." [1] Pieczenik describes the progress of America's relations with China: "During the period 1940-45, China had a government whose nominal head was General Chiang Kai-Shek. That government was a tenuous coalition between the

Kuomintang and the Communist party. During that period America's foreign policy posture toward China was as an ally against Japan and was supportive, if not overwhelmingly sympathetic. The balance-of-power vulnerability vis à vis China was minimum." Pieczenik then describes America's rapidly changing attitude toward China: After World War II, our primary concern was to withdraw our troops and leave China to handle its own civil war. A 1946 Gallup poll showed that 50 percent of the American people were in favor of total withdrawal. The American government, however, sent George Marshall to negotiate a settlement between the warring factions. At that point we saw the nationalist Chinese in terms of an all-powerful, all-good Kuomintang, superior in manpower and weaponry (a psychiatrist would call this attitude a fantasy of omnipotence) and led by Chiang Kai Shek, whom President Roosevelt called a "major post-World War II leader"(primitive idealization). Chiang's opposition, our government felt, was an inferior, Russian-dominated, communist force.

But in 1949 the communists won the mainland, an event that produced a maelstrom of anger, confusion, and frustration in the United States. Everything we had fought for was lost, and we needed a scapegoat. The scene was set for the establishment of the China lobby in Congress, which demanded and got military assistance for Chiang on Taiwan for the purpose of combating communism.

We all know the scenario since then. In psychiatric terms, Americans might be said to have employed denial, distortion, and projection to deal with our anger, anxiety, and frustration over our defeat on mainland China. Now, following Richard Nixon's visit to the mainland, our mechanisms of defense are changing as talks and trade agreements develop.

The rules are always changing. Humanity is under the constant impact of

external events, which are internalized in the light of preceding events. The relationship with other nations is continually perceived through the prism of past experience. On the most intimate level, the children of a particular nation are burdened with the hurts of their parents and even of their grandparents, and this phenomenon is the first emotional component of international affairs I wish to address.

During their development, all children want to perceive their parents as strong and invulnerable. Parents who suffer at the hands of an aggressor often transmit their hurt and shame; they burden their children with the desire for revenge, and the children seek revenge not from a particular anger at their parents' oppressors , but because they are ashamed of their parents' impotence. They want to show themselves victorious over both the enemies of their parents and their parents, a need that lends special virulence to their activities.

A case in point is that of the Moluccan terrorists in the Netherlands, who recently held 160 hostages--105 of them children--supposedly in pursuit of their parents' dream of political independence.

The background to this sad drama is this: Indonesia was part of the Netherlands East Indies for more than 150 years. It was granted independence in 1949, and at that time, a million Moluccans in Indonesia proclaimed their own independence. The new Indonesian government brought this separatist movement under control, killing 1,000 Moluccans in the process. Moluccans blamed the Netherlands for this tragedy, arguing that they had been assured the right to secede from any government formed after independence. South Moluccans, moreover, had been converted to Christianity during the long period

of Dutch rule and had served in the colonial armies beside Dutch soldiers. Several thousand of them left Indonesia during the futile battle for separate government; they emigrated to the Netherlands, where they were demobilized.

The terrorists who have plagued the Dutch and Indonesian authorities and the International Court of Justice at The Hague for ten years are the children of these Moluccan soldiers; they have never seen the native islands of their parents and grandparents, but they certainly have felt the wounds their parents felt from exile and defeat. Moreover, the parents identified with the colonialist Dutch: They embraced the rulers' religion; they went to the rulers' homeland. To their offspring they communicated their anger at the oppressor, the Indonesian government, and possibly a displaced anger at themselves for having identified with the Dutch, inspiring in their children a particularly violent desire for revenge.

As do young Palestinians throughout the world, the Moluccans commit vitriolic, terrorist acts in the name of a homeland they have never seen. Their extremism is partly the result of a complete lack of reality testing: To young Palestinians scattered around the globe, the oranges from Jaffa are bigger than life.

Psychiatrists would describe the emotional aspects of the activities of young and vengeful groups as a form of displacement: One generation assumes in distorted form the hurts of its parents. The Bangladesh and Arab-Israeli conflicts bear all the marks of this. It is particularly obvious in the case of the Arabs and Israelis: Israelis see the present world arena and their present enemies in the light of the experience of their race. Israel was

formed by survivors of pogroms and concentration camps. The Arab perception of Israel is colored by the Arabs' experience in the Caliphate and under colonialism. Historical attitudes like this prevent real contact and therefore decrease the opportunity for reality testing. The result can only be destructive.

It is important, therefore, that international policy makers be sensitive to the mass hurts--national wounds, as it were--that may exist. Such injuries are not healed by time: There is good reason to believe that the hurt transmitted from one generation to the next is markedly aggravated as it crosses the boundaries of time and place.

I am recommending empathy in international decision making, an approach usually perceived as unrealistic and moralistic. But empathy is an essential tool for wise decision making. It is necessary to understand a situation from your counterpart's point of view; it is necessary that the leaders of one nation grasp what motivates the leaders of another.

The superpowers are locked in an intricate, almost intimate relationship: They distrust one another and usually misinterpret one another's actions. The rest of the world, especially the developing nations dependent on the superpowers, find their mutual distrust magnified by interior conflict: Developing nations need the resources of the superpowers; at the same time, they need to assert their independence in the world arena.

This inner conflict naturally creates tension and unrest, markedly increased by the profound gap between the needs of industrial and the needs of developing countries. Here is an area where accurate information and sensitivity both are

crucial. The external realities and accordingly, the expectations, of industrial and developing nations are very different. The differences appear most marked in international meetings, those dealing with foreign aid, for example. Individual people, especially government professionals, who travel to meetings may be very much alike, but that does not mean that in their own countries they experience similar realities. I recommend that one put oneself in the other person's shoes. It is important first to discover whether he has shoes.

Among powerful nations, decision makers misinterpret one another's intents and motives with startling consistency. The general tenor of thought seems best expressed by Robert Jervis in his excellent book, Perception and Misperception in International Politics.[2] Jervis says decision makers generally believe that their opponents carefully plan their moves. Favorable actions are a response to the decision maker's own behavior; unfriendly acts spring from unprovoked hostility. It's a common enough stance. To correct it, one must have information about one's national consciousness and motivation as well as information about the national consciousness and motivation of one's opponent.

Awareness of one's personal biases and wishes broadens the horizons of communication. The diplomat increases his personal flexibility if he is aware that his decisions frequently are molded by previous experiences in other spheres and under completely different circumstances. A fear of another Munich or another Vietnam prevents a realistic assessment of the present. The diplomat who makes an effort toward sympathy and understanding is not compelled to see any particular conflict through the prism of a particular historical lens. He acquires alternate paths toward the solution of conflicts.

The decision maker who is aware of his own and his nation's biases will realize which incidents provoke his hostilities and will be more able to understand, evaluate, and possibly even avoid provoking hostilities in

other nations. People--including decision makers--usually are sharply and intuitively aware of their antagonist's vulnerabilities: They know how to hurt where it hurts the most. Emphasizing vulnerability is inflammatory behavior, frequently locking conflicting nations in a danse macabre. For example, the words "homeland for the Palestinians" have a red-flag effect on all Israelis, whose entire justification for Israel was to create a homeland for Jews. Israelis have been able and have felt justified in using all means toward that creation. "Homeland for the Palestinians" is a deeply unsettling phrase for them. Each time we are confronted with something in ourselves we prefer not to see, we perceive the one who provokes the confrontation within us as an enemy who wants our destruction.

Subtlety, therefore, is of critical importance in international communications, particularly in those with easily discernible emotional overtones. Subtlety does not mean ambiguity and uncertainty. It simply represents an awareness of--and a disinclination to abuse-- the vulnerabilities of the concerned parties. An analogy from psychiatric practice: The parents of mildly mentally retarded children usually are extremely sensitive to the term "mental retardation" in connection with their offspring. They will go from expert to expert, hoping for a different diagnosis, any different diagnosis, because, unaware, they are angry at themselves for their shame at having produced such a child. In skillful interpretations to these parents, one does not give a misleading diagnosis. One first gives them an opportunity to express their hurt and shame as well as their anger at the messenger and at themselves. Then one asks at what age level their child performs, and they provide the real diagnosis by saying something like, "He performs three to four years below his age level." The attitude works on a much grander scale. Sensitivity

to the special hurts of nations or groups within nations can only decrease tension and distrust.

With its organizational bureaucracy and its code from other times and other experiences, diplomacy itself often increases ambiguity and uncertainty. Its language stresses indirect communication, and its function demands that public statements be made always with the interests of one's own nation in mind. The responsible diplomat is aware not only of his intellectual expertise but also of his affective ties and how these influence him. The expert in a particular foreign area has knowledge he could not have acquired without developing strong emotional ties and therefore biases of one sort or another toward his area. He never should pretend that these biases do not exist. They do not disqualify him from his job, they qualify him for it. On the day of Nasser's death, I heard a former US ambassador to Egypt emphasize his objective disinterest in a proposal concerning the Middle East. At the same time he recalled, almost with tenderness, the warm relationship he had had with the dead Egyptian leader. Our UN ambassador, Andrew Young, apparently understands the sources of his passionate attachment to the cause of South African blacks. His awareness can only make his difficult mission easier; it decreases his own ambiguity.

Those dealing in foreign affairs never can afford to be complacent. As I said earlier, international situations are in a continual state of flux. Diplomacy requires continual attention to one's own--and one's opponent's or ally's--affective reactions. Robert Jervis quotes Harold MacMillan's statement about his incorrect prediction of American behavior during the Suez crisis: "'I believed the Americans

would issue a protest, even a violent protest, in public; but that they would in their hearts be glad to have the matter brought to a conclusion.'" Jervis comments, "He [MacMillan] had not misread Eisenhower's warnings--instead, conclusions derived from his longstanding knowledge of America and its president outweighed the evidence derived from the contemporary messages."[3] The decision maker must see himself and his counterparts as continuously changing under the impact of new realities. Fixed presumptions about certain countries or certain leaders rigidify the international environment. If it becomes a matter of personal pride to the decision maker to prove to himself that his assumptions are correct, he can dangerously misunderstand the international milieu.

We all are familiar with the infectious quality of mistrust and tension in daily life. In relationships among nations, the stakes of the conflict are extremely high, and every effort must be made to smooth the paths of communication. Policy makers must develop a great sensitivity to the emotional needs of their counterparts in other countries. This means they must direct their attention away from themselves from time to time, which for a leader is a difficult task, since the mastery and power needs that put people in high places tend to exclude humility.

The decision maker must ever develop new images to conform with changing realities. He must beware of confusing his personal motivations with "national security needs" or other rationalizations for conflict. To see the world as it really is and to deal in it effectively, the leader needs a multiplicity of viewpoints and a constant flow of information. The lines of communication must always be open, communicators must always be sensitive. Individuals and nations have a great proclivity to perceive only that in a situation which is most

intimately related to personal or national experience, and in critical periods this way of perceiving can prevent intelligent policy making.

In international affairs, the important task is to change from defensive stances to accommodating, coping behavior. The latter stance, with its accompanying decrease in mistrust and tension, can be achieved through a communality of interests. In the last analysis, nations, no matter what their power, economic, or strategic struggles, have a basic common interest: To survive.

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27th Pugwash Conference

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Birgitta Linnér (Sweden) XXVII-25

STATUS OF WOMEN - POPULATION - DEVELOPMENT

The three concepts of my title may be regarded as substructures within the larger structure which we call society. They are interconnected: if you affect one, you affect the others.

The status of women is an integral part of development and closely interconnected with population growth. It is not possible to accomplish development not to curb the population growth without improving the situation of women.

It is only quite recently that the United Nations has adopted new declarations of human rights, aiming at equality in society, in family and in personal relations between women and man:

> "Discrimination against women, denying or limiting as it does their equality of rights with man, is fundamentally unjust and constitutes an offense against human dignity."
>
> (1967 UN Declaration on the Elimination of Discrimination Against Women)

Regarding population and women/men the 1968 UN Conference on Human Rights in Teheran stated on family planning that:

> "Couples have a basic human right to decide freely and responsibly on the number and spacing of their children and a right to adequate education and information in this respect ..."

And finally, about development and women, it was not until 1976 that the UN General Assembly approved an economic resolution, entitled "Effective Mobilization of Women in Development", urging equal participation of women with men in all developments efforts.

Thus, most is still at the resolution stage. I wish to elaborate, even if only briefly, about current thougths in the field of equal chances for human beings, a concept which is new in many countries.

THE REALITY - A SHORT CATALOGUE

1 The global population is now over 4 billion, UN Demographic Yearbook 1976. The population increases with about 80 million persons yearly (80% in the Third world). In the year 2000, the world population is estimated to be more than 6 billions. Never before has so many women given birth to children as during the 70's. More than 6 million children are born "extra" every month. The population is rising with 2 babies every second. With bad effects on women.

2 It is estimated that 500 million children are malnourished or dies from starvation and poor hygiene. In extreme cases one of four children dies before the age of one year. The position of women is obviously involved in these difficulties. I quote from UN Fund for Population Activities Newsletter, March 1977, about reasons for the high death-rate: (1)

> "But one of them is the pattern of large families with short intervals between births which results frequently in ill health or low resistance and sometimes in death for both mother and child.
>
> The pattern repeats itself when parents, unable to feed or clothe their large families or to pay school fees, are forced to allow their children to leave school early to find employment - employment which is difficult to obtain without basic skills. And so a new generation grows up to a life of subsistence and procreation."

3 There is an increasing recognition in the world of the women's right, with privacy and integrity, to determine the number and the spacing of her children. Nevertheless, it is estimated that 1/3 of all women live in countries with limited access to modern contraceptive techniques, medically safe abortions, voluntary sterilizations or family planning information. They have to rely on illegal and unqualified abortions, risking untimely deaths, or medical complications and other side effects. However, the right and means of fertility regulations are not enough. Family planning programmes are effective only when they are combined with socio-economic development, including such aspects as late marriage for women, small families, and increased literacy and employment (2, 3, 4).

4 About half of mankind is youth under 20 years of age. There is a growing proportion throughout the world of unwanted pregnancies among adolescents, with high maternal and infant mortality risks. Also, both the child - many times regarded as an illegitimate child - and the mother are victims of social and legal discrimination in many countries.

Adolescents receive a disproportionately small share of publicly funded family planning services as well as inadequate human sexuality education, in most cases none at all. It is a vital observation that control over and delay of the first pregnancy probably opens up more options to women than does control over any subsequent pregnancies (5, 6).

5 Illiteracy is rising, due to the population growth, and more among women than among men.

Research evidence shows that increased female literacy delays marriages and provide women with better employment opportunities.

6 It is estimated that 1/3 of the world's paid labour are women. But there is a big difference in many countries between wages to women and men, even for equal work. And in unemployment crises women are mostly worse off.

7 It has been estimated that between 1/4 and 1/3 of all households in the world are headed by single women, left alone to fend for their families. In some countries single women are head of the household in about 80% of the families. (Social studies at the Demographic Association of El Salvador (7). These families constitute a major section of the poorest element in many societies, more or less industrialized alike.

8 The difficulties of combining motherhood and economic activity have been poorly recognized in many countries.

> "Many employers dismiss their female workers when pregnancies are suspected. Knowing this, many women choose to have abortions rather than risking their jobs." (7)

In addition child care facilities are seldom available outside the family.

9 Most women in countries with an agricultural economy work hard at subsistence farming or domestic work, but are frequently unpaid or undervalued.

And even in rural regions where women traditionally have rather high status as providers of food for their families, their role is threatened when large-scale mechanization is introduced in agriculture. Machines are regarded as men's business in the division of labour between the sexes.

10 In many countries the husband is considered as the head of the household and the family, and thus superior; the housewife with her subordinate role is not considered to be valuable in economic terms, either in the home or in the community.

Right across the enormous variations that are due to political and socio-economic class-structures, cultural and religiuos traditions etc, the fact remains that the majority of the world's women are considered inferior to men - far away from the possibilities to share equal responsibility for planning and decision making of the future.

PARTICULAR UNITED NATIONS MEASURES

The 1974 World Population Plan of Action passed at the Bucharest Conference recognized the importance of the raising status of women as a means of curbing population growth. Full integration of women in development, on equal terms with men, was recommended. This implies that development of a society means the development of each individual within it, also women.

The World Plan of Action adopted at the World Conference of International Women's Year in Mexico City in 1975 emphasized particularly that there are major connections between development and the role and status of women. But so far there has been very little research in depth on these linkages, and little practical application of what is already known.

The UN General Assembly has proclaimed the years 1976-1985 as the Decade for Women: Equality, Development and Peace. As repeatedly underligned by Helvi Sipilä, Assistant Secretary General

of the UN, we shall not reach any development if the situation is not improved for women.

These are interesting initial moves in the United Nations and its organisations. But they are only first steps, and omissions are still prevalent, as indicated by the following examples.

At the World Food Conference in Rome, Fall 1974, the inter-relationship between nutrition and food and the status of women and development was largely ignored. Generally, agricultural instructors forget the women and turn to the men when introducing their modern techniques. This is especially serious in Africa where women traditionally do about 70% of all agricultural work but they have only been admitted to about 15% of the educational training inside agricultural life. (ECA, UN's Economic Commission for Africa.)

The UN Conference of Human Settlements at Vancouver, Canada 1976, the largest conference ever in UN history, referred to the inter-connection between the population question and the human settlements problems. For example, Rafael M Salas, Executive Director of UN Fund for Population Activities, talked about the "totality of development", believing that only in this way can the purposes of population programmes be fulfilled.

But - all the same, women were forgotten or ignored. The only official mention of women and their world appeared in two late amendments which put women in the same category as the "disadvantaged" and the "infirm". This was done in spite of knowing that also female migration to the cities is a major problem in most developing countries. (By the year 2000, 50 % of the world's population are expected to be living in cities, compared with only 39% in 1975 and 29% in 1950.)

In the UN Water Conference in Argentina in March this year, 1977 I don't know how much the interests of women on this issue have been analyzed and formulated and integrated in the documentation and conference debates. The major interest of women in the provision of convenient and safe water supplies, especially in rural areas, should be obvious. Contaminated water is a prime cause

of infant mortality and generally poor health standards; food production and animal husbandry are limited by lack of water, and so on. (Compare a United Nations Children's Fund, UNICEF, projekt, related to the Government of Kenya's Water Programme, which has as its goal the provision of safe water to every household by the year 2000.)

OTHER ORGANISATIONS

The United Nations Organisation is always in the limelight, and its attitude often sets a standard followed in wider circles - even scientific ones.

Some more examples of the male oriented world

The UN University in Tokyo and the Royal Swedish Academy of Sciences held a conference in Stockholm early 1977 on Human Survival, Development and Social Welfare. The role and status of women was missing in the planning of the Conference. When a Norwegian woman delegate explained that women have to share leadership for planning of the future, some delegates understood that the conference had missed an important area, but others intimated that this delegate was just one more woman having difficulties with her women-identity and therefore not to be taken seriously.

I hope that in future years the UN University will come around to include women in its programme and research planning.

The Club of Rome and the International Federation of Institutes for Advanced Study, IFIAS, are co-planning a conference in Sweden in the late 1977 on "The World food-problem, environment resources and population problems." It will be interesting to see if these two organisations will take up the role of women in the conference, both in micro- and macrostudies. I am sceptical: the second report of the Club of Rome, with its pretentious title of "Mankind at the Turning Point" dedicated to "Future Generations", mentions women only in a short chapter on age-structure and population growth (9).

The Club of Rome, in its third report, presents population squarely in the middle of the problem stage, as exerting tremendous pressures on the social and economic systems of the developing countries. But still women are not considered as equal partners in the proposed planning for the future ...

WHAT CAN BE DONE?

Fertility regulations have mainly been considered as demographic tools and have not been correlated with the status of women and development. There are new trends now and the most positive approach I have met is in the recent UN Fund for Population Activities Project Formulation on Women, Population and Development where women are integrated at all levels. I quote:

> "The objective of fertility regulation should not be exclusively for demographic ends but should also encompass the objective of freeing women from unwanted pregnancies in order to improve the health and welfare of mothers and children. Good health is a prerequisite for the exercise of any options open to women in order that they may participate equally in the economic and social and political life of society." (10)

The World Health Organisation, WHO, has also adopted a new approach in recent years, considering the health of mother and child as a basic concern. But still women are not participating in the planning and decisions as fully as in the UNFPA-project mentioned above.

The WHO expanded Programme of Research, Development and Research training in Human Reproduction has a new research project on attitudes toward family planning, and social aspects of family planning. Even here much remains: it is mainly a research planning by men for women. However, at the WHO Psychosocial Centre in Stockholm, there are about as many women as men in the Research Planning on Psycho-social Factors and Health.

Things take time and there are many difficulties. The Swedish International Development Authority recommended in 1973 that the role of women should be considered in every planning document for development. Two years later an evaluation was made to see how the recommendation had been observed, and the result was discouraging. It is easier to define a problem than to tackle it.

Finally, at the time when promoting the establishment of a new international economic order has come to a fore, it is of vital importance that the resources of women are taken seriously, as women have played and still play a substantial role in the economic development of their countries. It is also of vital importance that women with their knowledge and potentials participate in the planning and decision-making of the new economic future.

PUGWASH AND THE STATUS OF WOMEN

During the first part of the 1970's, population and development questions were part of the Pugwash programme.

At the Oxford Conference in 1972 the women's situation and its connection with fertility regulation was discussed in a paper on "The necessity of national Population Policies" in the section of World Resources and Population Problems.

At Aulanko, Finland, in 1973, a plenary session was dedicated to the global population problems, including "Family planning and the status of women".

The "Statement on the Pugwash Approach to the Global Population Problem" for the Bucharest World Population Conference, August 1974, expressed that "The provision of equal status in society for men and women, through equal opportunities in education, employment and decision making, is a fundamental principle in itself but also an important factor in reducing population growth, and must be assured."

At the Madras Pugwash Conference in 1976 on "Development Resources and World Security", the line was broken, however, judging from the proceedings.

I am suggesting here that the line from the previous conferences should be continued. The status of women is, and should remain, one of Pugwash's concerns.

There can be no doubt that this subject is a scientific one and its evidence is based on observations: population and development on one hand, and the status of women on the other hand, are demonstrably interconnected. Improvements in the fields of population and development will be blocked unless the situation of women is changed. That is why the status of women should not be treated as a subordinate theme, but should be given the same priority as population and development. Let me conclude by quoting from Development Forum, a journal published by the UN:(11)

> "Real solutions to global problems can be achieved only by mobilizing the resources of the whole population. Tapping the potential of women could by itself mean all the difference between success and failure."

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27th Pugwash Conference

Munich, Federal Republic of Germany, 24-29 August 1977

E. Broda (Austria) XXVII-2

THE THREAT OF WAR AND THE ENERGY PROBLEM

1) Energy consumption and armaments.

Two of the major problems of our time, the threat of nuclear war (by far our most important problem) and the energy problem, are generally treated in parallel, as if they were independent. For instance, they are kept separate in the agenda of the Pugwash conferences. However, the two problems are in fact very closely intertwined, and it is essential for a solution of the problems that this should be understood.

Clearly, the hunt for cheap energy may lead to war. Nobody will deny that in their desperate craving for abundant and cheap energy countries may be tempted to apply the threat of war to promote their presumed interests. Many local wars for oil were waged in Asia, Africa and Latin America; this has often been shown by historians and journalists, and even by novelists. Concerning the recent past, one recalls the serious threats against oil exporting countries when the so-called energy crisis broke out. Obviously, in our time any war can quite easily develop into a nuclear conflagration.

But there is no sufficient realization to what extent the converse statement is also true, namely, that the energy problem is enormously aggravated by the danger of war. Generally, a large part of the national income goes to the armed forces and to factories making armaments. This applies not only to the

great powers but also to many other countries, including the new rich in the Middle East, and even to the desperately poor countries of the Fourth World. Clearly expenditure of money goes hand in hand with the expenditure of energy. Energy is needed for the production of steel for arms, of cement for military construction, and of food for the soldiery. Trucks and planes consume fuel. Expenditure is far larger still in actual war; the amount of energy used in Vietnam must on the American side have been quite fabulous. A cessation of expenditure for the military would immediately put an end to many difficulties in energy supply: it would be far more effective than the -- welcome -- conservation measures now in the minds of the experts.

Not only direct expenditure for the military and for armaments is relevant. Thinking in terms of possible armed conflict, many countries have decided to support, even at heavy financial and energy cost, those branches of the economy that are thought to contribute most to a powerful position in the area or in the world, be it only by way of prestige. Favourite children are, for instance, mining, metallurgy and heavy industries, the making of ships, trucks and cars, of certain chemicals and of electronic hardware. Strategic roads and railways are built on a large scale. It should not be beyond the capability of statisticians to work out the cost of all these activities in terms of energy expenditure. But even without their data we may be sure that the results would be staggering.

2) The bane of competition.

Knowledgeable people feel that with an energy consumption of about 10 kilowatts per head the leading industrial countries have reached, or overstepped, the limit of what is desirable for welfare. Quite possibly true human wellbeing does not require a further increase of energy production in the developed countries. Maybe the new Stockholm Energy Institute will work out recommendations about the desirable level. This may be below the present level in the developed countries though it will surely be far above the level in the developing countries. It must be hoped that serious consideration will in this context be given to the military contribution, which ought to be reduced radically, and later suppressed.

Unfortunately, at present the arguments in favour of limitation of energy production and consumption in country A fall flat in face of the question :"How will limitation affect our position in the world ? Presumably country B (and maybe C) will continue to raise energy production, and the balance of power will thereby be shifted to our disadvantage ".

We may compare the situation in an analogous field, that of population. I shall take as an example my own country, Austria - a small country, and in our time not exactly one of the most difficult or aggressive countries ! Looking at our towns and the densely populated countryside, and considering the increasing destruction of nature by building activity everywhere, much of it for luxury purposes, nobody in his senses should hold that our number is too small, i.e. that there are too few Austrians. Nevertheless, the unbelievable is true. When in recent years statistics indicated a decreased

rate of population growth, tending towards zero, the mass media, especially the dailies with the largest circulation, howled as if this were a disaster. The reason why a decreasing rate of growth should be a disadvantage, indeed a defeat, is never clearly spelled out. But it is clear that consciously or unconsciously our situation is compared with that of some of our neighbours where growth of the population still continues.

The consideration is, then: how does a stationary population at home affect our chances in competition and possible conflicts with our neighbours ? I chose Austria as an example, but clearly, the situation is similar everywhere.

The worst feature is that those unspoken (or spoken) arguments cannot even generally be said to be baseless. Who could maintain that the balance of strength between, say, Greece and Turkey is not affected by population size ? Or, to return to the energy problem, by the relative values of power production and of engineering capacity ? We may conclude that voluntary limitation of energy production or consumption on an important scale cannot be hoped for in a world dominated by international conflict.

In particular, the equalization of energy consumption in the developed countries, on the one hand, and in the developing countries, on the other hand, to which lip service is often paid, is prevented by international tensions.It is easy enough to start exploration for oil or to build power stations in this or that backward country as long as the balance between the "superior" and the "inferior" countries is not affected thereby. But can it really be believed that the most highly developed countries, among them the ex-owners of the colonies, really want to

abolish the difference in economic and military strength, largely expressed in the level of energy production and consumption

between themselves and their former possessions -- and in this way to enable the ex-colonies to extricate themselves from dependence, and even to settle old scores ?

3) Unlimited growth or reduction of working time ?

In the developed countries, early limitation of energy production must come -- in spite of what semi-literate experts from industry tell us. With an increase of 7% of electricity production per year, as fiercely demanded by leading experts, e.g., in my country, the capacity of the power plants must increase sixfold by the end of the century, and 36 fold within 50 years. 36 power plants wherever there is just one now ! This is, however, impossible. Thus the question is really not "yes" or "no" to limitation, but earlier, voluntary, planned, limitation versus later, forced, chaotic, limitation, enforced by circumstances.

In the past, social thinkers, including the founding fathers of scientific Socialism, did not expect unlimited economic growth. The idea was rather that after the attainment of a production level which makes possible a full life any further increase in productivity would be used to reduce the length of the working day and/or working year. Now while in the developed countries working time has indeed been shortened, the increase in productivity has by far not been compensated thereby, and there is no intention of such compensation at a later time.

Large parts of the population have seen such increases of their purchasing power that they cannot only cover all needs of which our forefathers could think, but that more and more products are invented by the indefatigable capitalist industry to scoop off excess purchasing power. Many of its products do not contribute to true wellbeing, or they even detract from it, but frank advertising and especially the insidious influence of the mass media see to it that it becomes a matter of imagined need and of prestige to acquire all the new products, from colour television to the private, electrically heated, sauna. No end to be seen.

Nothing said here must be misconstrued as meaning that the supply of energy to all sectors of the working population (or, e.g., to old-age pensioners) in the developed countries is satisfactory. On the contrary, in many cases the standard of life is still in need of radical improvement. But looking at the overall level attained it does appear that this aim can, and ought to, be reached by changes in the national way of life and by redistribution of income (and, therefore, of energy consumption) rather than by a brutal overall increase of energy production. To quote a friend : The solution of the social problem cannot consist in letting the loaf grow until the crumbs are big enough for the hunger of the poor.

The considerations about growth are valid in a world without nuclear power, and, with even greater force, in a nuclear world. We are told that so and so many jobs would be lost if we stopped muclear construction. Why does nobody argue: It is really a good thing that productivity has increased so that therefore we can reduce working time generally

to reabsorb these workers, without reducing wages ? This thought seems to have been lost, although to old-time Socialists, among others, it would have been rather obvious. According to current ideology, we have to build nuclear power stations, and the Concorde, to keep people busy.

4) Side remarks on fission and fusion.

Competition also influences the safety aspects of nuclear (fission) technology. Countries are reluctant to introduce effective, and therefore expensive, safety standards, e.g., in respect to waste disposal, because they do not believe their neighbours to be equally careful.

Here we might slip in a more general consideration about nuclear fission energy. The various objections to it, in order of increasing seriousness, are : routine releases of radio-nuclides, difficulty of waste disposal*), possibility of technical disaster, trend towards a police state, nuclear war. They all stem, in the last analysis, from a common root. Man and his phylogenetic ancestors dealt with mechanical and chemical forces only. The bioenergetic processes are chemical processes, and the inventions of man - manufacture of goods, mechanical locomotion - are also based on chemical and mechanical processes. During the ages, living matter has adapted to mechanical and chemical forces. Until recently, it never had any need or opportunity to apply the nuclear forces, which are, per unit mass, millions of times stronger than the chemical forces.

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*) It is curious that in the discussion about the wastes from nuclear power plants and reprocessing factories sight has been lost of the enormity of the nuclear wastes already generated by the military plutonium factories; according to B.L. Cohen, in USA a hundred times more than by civilian installations.

Thus on the basis of our natural heritage we lack the senses, the receptors, for nuclear processes. E.g., one can easily absorb a lethal dose of gamma radiation without even noticing it. But man also has no instinctive capacity to deal with these forces. Therefore, the natural reactions, common to all mankind, must be replaced by purely intellectual processes, accessible only to a small minority of highly-trained experts, supported by computers. But the experts also do not appreciate the long-range effects of their actions. The task of controlling the nuclear forces might be too much for humans in war and in peace.

Now what is to be done about energy ? Of course, scientific-technical progress in the energy field must go on. Far more serious work must be invested into the search for methods of energy conservation and for alternatives to fission power. The feasibility of fusion power (or, for that matter, of large-scale geothermal power) has not been demonstrated. Moreover fusion energy, like fission energy due to nuclear forces, is objectionable on various technical, environmental and economic counts. In any case, fusion power would involve staggering overcentralisation of energy production in huge plants that can be run only by some select people in a few select countries; in this respect fusion power would be even worse than fission power, The principal aim must therefore be, in addition to conservation, the development of solar energy. This has been argued in more detail before.

5) Conclusion.

While scientific — technical process in the fields of energy conservation and production is indispensable, we insist that the question of energy is subordinate to that of international relations. The danger of war, or of threatened war, must be lifted before solutions of the energy problem can be found. Competition, driven by the threat of war, will always prevent reasonable limitation. The central problem is reliable world peace and disarmament. Only if and when this problem has been solved, solutions of the (very different) energy problems both in the developed as in the developing countries can be expected.

We do not argue in favour of a static world. We want development in the distant as well as in the near future. But change should be rational and planned. The driving force should not be the blind selfishness of minorities operating for profit or the exploitation of privileges at the expense of the rest of mankind. War and the threat of war must go. This is imperative from the energy as well as from every other point of view.

27th Pugwash Conference

Munich, Federal Republic of Germany, 24 - 29 August 1977

I. Supek (Yugoslavia) XXVII-3

COMMON GROUND FOR WORLD UNITY

There are many different countries in this world, with different social systems and traditions, and in the face of this diversity it is legitimate to ask whether we can find common ground for mutual understanding and a peaceful future. It can hardly be denied that the elimination of the arms race and the establishment of lasting peace, the rational use of the earth's resources and the just division of labour require a united world, but the whole concept of this unity, and even the possibility of its attainment, is confronted by many doubts and uncertainties. First of all, we would keep the construction of a uniform and all-encompassing world order out of consideration in this paper, due to the fact that a clash between different political blocs would result in total disaster.[1] In addition, the loss of the variety of different civilizations would certainly make our earth the poorer. It is not only political wisdom to accept the principle of coexistence. Different cultures enrich our world and make collaboration and communication even more desirable. For these reasons, we do not pretend to picture a utopia for everybody's salvation and conduct. The aim here is much more modest: to propose some principles which may be acceptable to everyone, in spite of different political, ideological and religious opinions, principles which are also essential for the whole of science.

Identity of All Human Beings

Among all scientific discoveries, we can regard that of the evolution of all living beings as safe from doubt. This truth has been affirmed in many independent ways, and without it we would lose our understandig of nature and of ourselves. Accepting evolution as our guideline, we first view men within the entire animal realm and, second, we settle the identity of human beings. The philosophers that regard men as basically different from animals are contradicting evolution, and are not able to understand the many similarities between homo sapiens and other higher mammalia. Moreover, their eventual humanistic approach might be too narrow in excluding a proper relation to nature. We regard all human beings as identical, mainly because of their common origin and their common basic needs (or properties).

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1. The vision of total nuclear disaster was first publicly announced at the Congress of Cultural Workers of Croatia (partisans) in liberated Topusko, 25 - 27 June 1944 (fourteen months before Hiroshima) with an appeal for the brotherhood of all nations and disarmament after World War II.

Undoubtedly work has become dull for many people (particularly in modern factories and also in schools), and laziness is often more a revolt against unnatural work than a natural state of mind and body. The same is true of dignity and position in society. It is well known that some natives perish when they are excommunicated from their tribes; and much of contemporary literature is concentrated on the problem of the alienation of citizens in modern urban society.

The concept of identity is something which is innate in human beings (as it may be with members of other species). In his history of the Renaissance, J. Burckhardt relates a case from southern Italy where a peasant went to a priest for confession, and after disclosing some 'sins' of minor significance, mentions with an air of innocence that he killed a stranger as well. It is also known that members of the same tribe will not kill each other, or only in exceptional cases, but there are no restrictions against their killing or even eating members of a different tribe, not to mention white men. The stranger is usually somebody whom one cannot understand, who has different clothes and behaviour, and only after these apparent differences have been overcome, by translation of language and arts, can the original identity be established. Although people live in different societies and environments, they are able to communicate and understand each other as a result of human imagination and comparison. Human thinking is never completely determined by social conditions; any human being has the ability to grasp what happens in quite different cultures. The identity of all human beings has its roots in their common origins but can be wholly understood with the development of languages and mutual relations.

Equality and Freedom

Once the common origin and basic needs of all human beings has been perceived, the concept of equality can be elaborated. One would certainly object to the statement that two leaves are not absolutely equal; and how may we speak of the equality of people? We presented our starting position, and now we can go a step further. Can we ever determine the 'nature' of a human being? If you try to put on paper what you think and feel now, you would always stop faced with the impossibility of expressing everything. Human acts have very complex and inexhaustible causes and motivations, and they are generally unpredictable. Only in some very definite, often repeated and almost automatic circumstances can one guess what will be done. We know how often we have been impressed by people that we believed we knew very well; how disappointed and sometimes how encouraged we have been. In every person is a potentiality for a variety of behaviour which can never be completely predicted, and when we take into consideration a particular person, we have to think about these immense possibilities. Upon this human potential are founded the concepts of equality and freedom.

Only thinking beings can be free. To speak about freedom in physics is senseless. Human thinking is never a mirror or reflection of outside processes but has been developed in active relations between man and man, and between man and nature, with all human needs, goals, aspirations, dreams etc. Philosophers who relate thinking only to physical behaviour or material production find difficulties in understanding the the first mythopoetic languages in which personal relations and desires prevail and are often transplanted to material objects. Thinking is connected with all human action and the attempt to separate thought and object, thought and action, is doomed to failure, as the whole history of philosophy shows.

Human freedom cannot be fulfilled without free expression or freedom of speech. Various prohibitions in this respect curtail human dignity and creativity.[2] For science and art, freedom of expression would always be essential.

Human freedom does not mean that our actions or decisions emerge from a vacuum, as existentialists supposed; human actions or decisions can only be regarded as being based on some reflection or motivation which is never completely determinable and in which there is a moment of imagination, surprise and creativity.

Traditional liberal theory has related freedom mostly to the choice between different possibilities. A man is free if he could have done something other than what he actually has done. In addition to this quality of freedom we would like to stress creativity as an essential element in human freedom. To create something new, to discover, to be curious -- these are all characteristics of human freedom. Creativity begins very early with children's play and grows naturally in social activity, culminating in reasoning in science and expression in art.

The principle of equality would oblige us to seek fair or equal satisfaction of basic human needs. This means nutrition, food, proper shelter, health assurance and equal opportunity for education for all. Moreover, we would like to see the same fairness in consideration for jobs. Certainly, this demand of equality goes beyond the traditional liberalism which formulated the principle of equality before the law only. For contemporary society it becomes essential to introduce democracy into the main activities of society, in economy, trade, transportation, education, etc. Different models of participation in decision-making could meet this requirement: self-management is one of the most interesting of these.

Universality and Tolerance

If each civilization completely determined human concepts and behaviour, there would

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2. Pugwash Conferences could appeal for the European Conference in Belgrade, 1977, to give more bone and blood to "the spirit of Helsinki".

be no world science and, moreover, members of different cultures would hardly understand each other. But such a condition is opposed to basic facts. Different Chinese, European and American societies do not produce a different physics or chemistry, and understanding between the respective scientists proceeds very well, in spite of ideological conflicts. The same is true of art. We understand and love the art of very remote cultures no less than we love our own. Any social relativism fails in the face of this discovery of the universality in human research and creativity.

We have not rooted universality in a realm of eternal truths or beings, but in the whole existence of human beings in the cosmos, with inseparable and complicated interconnections, capable of manifold development. The truth is not simply a correct statement about objective and independent facts but a human achievement in a correlation between various concepts and actions. The most elaborate scientific theory, such as quantum mechanics, would disappear or become meaningless if laboratories and experimental procedures were destroyed. Since physicists in all countries are able to agree on some basic concepts and laws, we can conclude that human relations to the cosmos, beginning with simple body movements and measurements in space, time and weight, are basically identical for all human beings.

Art is much more influenced by tradition and the present social and natural environment. Nevertheless, there is universality in its roots also, due to the play of human imagination, the common affection for nature and the depth of interpersonal relations. In a tragedy a real, possible, or even impossible life has been reconstructed in a most condensed and imaginative manner (with the main conflicts, moods and characters), and the tragic finale does not mean an end of reality but of an overtensed version which might be a moral appeal to the public. In exploring different ways of life, art is profoundly engaged in moral questions.

There cannot be a moral only for a specific group in a society, but one for all people. If a group claims to have more rights (or priveleges in properties, power and decision-making), it immediately violates our principle of equality and freedom. How can such a group be differentiated from a gang of robbers, who may among themselves respect personal dignity and property? Someone may reply that such a group may strive for the final happiness of all people; but if such a criterion is accepted, then this group erodes its own existence and submits to general principles of equality and freedom. Only a caste or fascist organization which expressly denies the equality of people could stick to a priveleged position or ideology, but this attitude is contrary to morals.

Such virtues as justice, courage, honesty, generosity and dignity have been admired in

all cultures, and the whole of early poetry is closely connected with personal nobility. There are common trends in each different perception of morality which ultimately leads to the universal formulation of morals as envisaged in a united world.[3]

The Ten Commandments of Moses are expressed in this universal form, as is the biblical maxim 'Love thy neighbour'. It does not mean that a Jew is not allowed to steal from another Jew, nor that a Christian has to love only another Christian. Certainly, these have often been practised as such, but the very character of moral commands, with an understanding of the identity of all human beings, has very soon established the universality of ethics, so necessary and decisive in this divided world.

We have not founded and built morality on eternal and absolute dogmas which might lead to a fanatic belief and adherence to a militant organization. Having recognized the historical character and fallibility of all concepts, as well as the power of the imagination in the creation of the new, we are obliged to be tolerant. Every sincere explorer has to admit to the possibility of error and to his inability to estimate completely the ideas of another investigator; at the same time he has to esteem the novelty created by the scientist's or artist's imagination. Tolerance is just adherence to the manifoldness and freedom of human creation. People who desire a preserved status quo or believe in a definite order of things (in the past or the future) usually have no respect for different opinions or attitudes. Consequently, intolerance prevails among militant nihilists who would like to destroy everything, culture not excluded. By spreading understanding of past achievements in science and art, we would give moral strength to tolerance among people, and approach our present problems more constructively.

Tolerance is one of the basic principles for human coexistence. According to this principle the majority, even in a most democratically ruled society, will never press its opinion on a minority, unless the actions of some individuals endanger life (as in the case of criminal behaviour). Men must always try to explore various ways of life, and such a plurality will, in a rational democracy, increase the richness of the world. The strength of a democratic society lies in its tolerance, even towards individuals who deny the basic framework in virtue of a dreamed-for utopia.

Solidarity and Communion

From youth to old age, man needs assistance; and mutual support is needed in all mature work. Friendship, love and communion are at the roots of each society, in spite of many divisions which detract from this basic solidarity. It ranges from pure humanitarian deeds in case of distress to more essential collaboration in social activities; and it has to

3. The moral implications of science have been treated at the 22nd Pugwash Symposium, on "Science and Ethics", held at the Interuniversity Centre, Dubrovnik, 14 - 18 January 1975. We expressed then a hope that Pugwash may adopt a code for the moral responsibility of scientists.

be kept up in all aspects.

Certainly the most important solidifying forces have to be strengthened in common undertakings which satisfy the basic needs of people, particularly with regard to the fact that many of these activities have been developed because of profit and other selfish drives. Since we do not wish here to plead for a particular political programme, we would like only to stress some points which are closely related to the principles of equality, freedom and creativity. It is quite clear that the work in any factory, workshop or field is the result of the experience and innovations of many generations. This is even more true in these times of scientific revolution where the productivity of labour has been so highly increased by the application of research. Under such circumstances, how can anyone claim private ownership over what has been the result of the efforts of so many? The defence might be made that such absolutism of private ownership and related private social laws was useful in the beginning of a new era, promoting personal initiative, but certainly today, with the huge increase of the means of production and scientific applications, the former liberal theory is obsolete, and is an obstacle to a rational world order. Bearing this in mind, it is legitimate for the workers in any undertaking to demand participation in all decision-making processes. To expand democracy from a purely juridical sphere to all spheres of social activity today seems to be the main requirement of human solidarity.

This expansion of democracy, if properly understood and presented, could be fulfilled in a non-violent and cooperative manner. It is quite true that high taxation, related laws and some intervention by governments have in many places reduced or regulated former ownership; but this transformation has to be induced in a more conscious manner, in creating better social conditions. In many countries we find increasing interaction between corporations and state agencies. If these state organs are conservative, they will certainly strengthen equally conservative elements in the corporations, and the whole state-corporation tandem will draw society back. Success can be brought about only if democratic actions, in both corporations and state organizations, proceed well. If by popular election a left government is formed, but the corporations retain power as before, the final collapse of government is almost inevitable. And conversely, if the democratic processes proceed well in the main spheres of social activity, by more participation in decision-making and in heightening human solidarity, but the state power remains conservative and even hostile to a new mass movement, a coup d'etat may dash all democratic hopes. A successful, non-violent action can only be introduced by harmonious changes in all structures of society, as well as in the economy, in culture and in the organization of representative bodies (state and parliament). Obviously the old state machine, a heritage from the time of monarchy and dictatorship, cannot meet the complex organization of various social activities.

Solidarity does not mean only social action but is also the expression of our friendship, brotherhood and love for other people. Without nourishing such feelings, any social principle would remain empty. Solidarity between people is greatly strengthened by their increasingly subtle human personal relations.

United World

There are three pressing reasons for world unity:

1. to stop the arms race and bring about security by disarmament and peace keeping;
2. to change and even limit the present rate of growth which is going to exhaust all natural resources and pollute the environment;
3. to erect a just world order.

Although the United Nations has stated that general and complete disarmament is their ultimate goal, nothing decisive has happened in this direction, and the arms race today is in full swing, with all its catastrophic consequences. It is hard to believe that any government which relies upon armed force and police is really sincere in its declarations concerning general and complete disarmament. Though we are prone to welcome all efforts on a governmental level, nothing decisive can be expected unless there is a deep change the global system of power. Here we see how the main problem of our time is ultimately connected with democratic movements.

Thinkers like Einstein adn Russell had lost their faith that anything could be done with the present governments, which follow only selfish interests without any insight into long-ranging and general problems, and in their distrust of these governments, advanced the idea of a world government created upon the will of all people. In spite of these justified motives, we can hardly imagine how such a world government could function, alongside nation states. There is a danger that such world tendencies would only increase the number of emigrants and prisoners. Bearing this in mind, we have pleaded for the UN, in spite of all its defects, as the best hope for a world authority, where the problems of the arms race and development may be ultimately settled. Certainly such an attitude implies a belief in the essential improvement of the UN, which again is possible through the improvement of all its members. Obviously all world problems are linked with national ones. Foreign policy cannot be separated from internal democratic or autocratic processes.

Instead of pressing for a world government, it seems more appropriate to develop all possible kinds of collaboration between different countries, with a gradual strengthening of some international bodies, not concentrated geographically (as is a seat of government). By such international collaboration in economy, trade, transportation, science, art and education, world unity may be brought about step by step.

would depend on the parallel steps taken by other states, especially the superpowers. When joining the system of collective security under the UN, national armies would automatically be reduced to a low level. The impact of these measures on social development and on the general climate for general and complete disarmament would be decisive.

According to all negotiation so far, and in view of the differences in the levels of armed forces, the first step in the disarmament of the superpowers must be large enough to leave both states with an equal minimum deterrent, which would also be put under the supervision of the UN. The rapid reduction in their military potential must be accompanied by the dissolution of military blocs and by the liquidation of military bases on foreign soil. After all this has been achieved, general and complete disarmament and secure peace could be ensured in a united, prosperous and just world.

Europe has been the birthplace of two world wars. Through the middle of Europe, NATO countries border those of the Warsaw Pact, with huge concentrations of military power on both sides. But Europe was also the birthplace of modern science and technology, which have spread all over the world, and also has promoted many social activities and visions of a better future. Taking all historical contradictions to a climax, Europe could also today contribute essentially to disarmament and the unification of the world. Perhaps the most important contribution in this decade would be the creation of a United Nations of Europe. Accepting the guarantees of the superpowers under the sponsorship of the UN, and in a UN security system, the new UNE could easily become an atom-free zone and zone of reduced armament spreading from Scandinavian countries to the Mediterranean. A United Nations of Europe would not only soften the contradictions between the two superpowers but would also solve many internal problems (self-determination right of nations, fair economical relations for all countries, free exchange of ideas, etc.) and appear on the world theatre as a beneficial force. In the present impasse, such an undertaking could save mankind from disaster.

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ARMS CONTROL : THE RETREAT FROM DISARMAMENT *

1. Détente and Armaments

Thirty years after the start of the Cold War, we still live in uncertainty and insecurity. The international community may have overcome the confusion and follies of the ideological confrontation but has not achieved peace. In a protracted and uneven process since the middle of the fifties, détente has signalled a turn towards greater soberness and relaxation of world tension. Yet we have made little progress towards military détente. In fact, armaments are increasing constantly at a disquieting pace. The world is now armed as never before and no reversal is in sight. We are actually in the midst of a fierce arms race expanding in all directions: quantitative and qualitative, conventional and nuclear, vertical and horizontal - a race extending to all corners of the world.

World armaments expenditures in the post World War II period have risen more than three times - coming up to the staggering figure of $300 billions annually at current prices, equivalent to the gross national income of almost two billion people in the poorest parts of the globe, i.e. half of the world's population.[1] The parallel growth in the sophistication of arms and their destructive power is beyond any comprehension. The world nuclear arsenals, in strategic and tactical warheads, surpasses the explosive power of 1,300,000 atomic bombs of the Hiroshima size which killed 78,000 people.[2] Nobody can calculate the effects of a war even if only a tiny part of these deadly weapons were to be used.[3]

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* This is a shortened version of a paper which contained chapters dealing with the historical background and the changed world security environment, and with an assessment of the achievements and failures of the arms control agreements concluded since 1960.

With the rush to arms continuously growing, it is time to pause and ask some pertinent questions about the utility, effects, and directions of arms control: the kind of agreements concluded in recent years, the nature of the exercise, and what it portends for the future. Does arms control pave the way to disarmament? Does it meet the initial expectations? Does it produce peace?

The main thesis of this paper is that arms control, as it has been implemented since the beginning of the sixties, and reflected in a number of multilateral and bilateral U.S.-Soviet accords, has not served well the cause of disarmament. It has not halted the arms race, but rather impelled its course. Arms control has not stood the test of history. There is a need for a broad discussion involving the concerned arms controllers, the scientific community, interested political circles, and a large public opinion to assess the situation and to search for constructive change. We seem to have floundered too far in the wrong direction, but we shrink from contemplating the actual and hidden cumulative effects of continuously piling up ever more advanced arms of mass destruction. We know that problems of survival are at stake, but a too frequent reiteration of the predicament has blunted our real understanding of the dangers ahead. Somehow we must get shaken out of complacency. There is a compelling need to rethink thorougly the issues of arms control and disarmament. An effort must be made to revive the demand and to initiate the process of real disarmament.

2. The Concept of Arms Control

Intellectually and emotionally, from the very start two trends coexisted in the arms control community. There were, first, the concerned believers in the pressing need for disarmament: aggressive idealists as met in the Pugwash movement, who were eagerly searching for a workable opening for the reduction of armaments and the elimination of nuclear weapons. And there was the other school guided by traditional strategic thinking as institutionalized in the U.S. Arms Control and Disarmament Agency established in 1961. In the process, the second trend prevailed. In the often quoted dilemma between the preferable and feasible, the idealists became resigned, consciously or unconsciously, to the pragmatism dominated by strategic analysts and traditional foreign policy balance of power thinking.

Ambiguous in the beginning, always stressing the goal of disarmament - parallel to the aim repeated in almost all the arms control agreements of general and complete disarmament - the concept of arms control became with the passing of time more explicit. It came to symbolize a practice of building security not on less but on more arms - balanced and agreed by the two main adversaries, the United States and the Soviet Union. Arms control - says Thomas C. Schelling - meant a 'break out of the traditional confinement of disarmament.'[11a] Instead of disarmament, most of the arms control agreements, and especially the SALT accords, actually issued permits for higher ceilings and more advanced weapons. The philosophy

behind this development was deterrence, first set forth in the Mutual Assured Destruction (MAD) precept, and later in counterforce strategies. Deterrence became the main theme of arms control, and it meant the establishment of a threat system which required a constant augmentation of armaments, so as to enhance the retaliatory power and be able to inflict ever greater damage on the enemy. The perfection of the threat system and the 'balance of terror' remains the most essential corner stone of arms control today.

2.1 Definition of Arms Control

The theory of arms control was developed mainly in the West but has been assimilated in the East and served practically as a framework for negotiations and accords concluded between East and West. The dominant definition of arms control ranges from the Dædalus list of aims: 'a) to reduce the probability of war, b) to reduce the costs of preparation for war, and c) to reduce the death and destruction if control fails and war comes,'[4] to Henry Kissinger's descriptive version, especially applicable to SALT: a) to make it 'less likely for either side to achieve a decisive advantage in strategic weaponry' b) 'to insure that these weapons will be used only in the most extraordinary circumstances,' and c) in case of war 'nonnuclear means would always be preferable, but I don't want to exclude nuclear means in certain situations.'[5]

It follows from these definitions that the goal of disarmament has been totally discarded and replaced by an exercise in crisis stability heavily relying on the threat system. While calling for mutual restraint and trying by collaborative action to regulate and adjust mutual armaments, arms control, in fact, rationalizes and justifies further armaments. It means constant war preparation by reaching out for ever more perfected means of deterrence.

Basically, arms control was a relapse into traditional pre-nuclear strategic analysis. Its concern was not to do away with arms and thus create conditions for lasting peace in the nuclear age, but to foster military scenarios, war-fighting

capabilities, and preparedness to strike and fight 'in certain situations', as stressed by Kissinger. Contemporary strategic analysts insist that nuclear wars can still be a continuation of politics, can be fought and won. They are not ready to accept repeated warnings by scientists that the consequences of military conflict in the nuclear age have become incalculable.[6] In reality, strategic analysis today is indulging in paper studies both deceptive and inhuman. Men are reduced to mere mathematical coefficients, humanity treated as pawns of overkill. The far-reaching political and psychological corollaries of such games are seldom contemplated.

2.2 Poles of Contradictions

In the political debate concerning arms control, the emphasis is often different in East and West. While the West tends more to stress the technological and control aspects of arms regulation, the East shows greater interest in the political impact. Yet, in the main, common ground is found both in larger defense build-ups and subtle diplomatic adaptation in foreign policy. While trying to codify rules of behaviour in their competitive relations, the outlook is for a dynamic world duopoly of strength, for economic linkages, and the avoidance of nuclear catastrophe.

Efforts to prevent catastrophe are commendable. Yet, if history should serve as a guide, such a balance of power has its obvious limits. Usually it has ended in war. Fortunately, the world has avoided nuclear conflagration for the last three decades. But contrary to widespread beliefs, this good luck has had little to do with arms control. It has rather been conditioned by historical events and circumstances on the international scene. Notable among these have been: a) the shift of conflict and of the main political contradictions from Europe to the Third World continents, and b) the need to consummate the great post World War II dislocations caused by decolonization, the reshuffle of empires and the imposition of new political borders. But with these transformations almost completed, new conflict constallations tend to emerge. Efforts to go on trying to rely on the regulating effects of

past arms control patterns may in such a dynamic new environment prove deceptive. The security of the superpowers themselves may not be fully assured.

There is inconsistency and contradiction in the current policies of arms control, in its many dimensions and component elements - military, technological, political economic, psychological, and ideological. Some of these shortcomings have been indicated above:

- the contradiction between the urgent need for comprehensive disarmament reflecting the exigencies of the nuclear age on the one hand, and the narrow framework of arms control on the other,
- the variance between the basically status quo oriented arms control provisions calculated to sustain a bipolar U.S.-Soviet world order on the one hand, and the necessity to adapt disarmament schemes to a dynamically changing multipolar international environment on the other,
- the disparity between the obvious requirements of reduction of armaments and overkill capabilities on the one hand, and the constant moving up the ladder of deterrence on the other,
- the incompatibility between the urgency for diminution of international tension on the one hand, and the perfection of the threat system on the other.

2.3 Flaws and Drawbacks

But the flaws and drawbacks of arms control extend much deeper. They involve the concept, the theoretical framework, and implementation.

Firstly, there is the delicate balance between the cooperative and competitive exigencies, set to operate in conditions of increasing armaments and exacerbation of military rivalry. While the centre of gravity in cooperative dealings rests mainly in political and economic linkages, the focus in the competitive sphere is predominantly in military fields. Yet to bring the two in line when, by definition almost, one component is meant to foster accord and the other at the same

time is posed to uphold threat postures, is, to say the least, a difficult proposition. In fact, while some advances can be noted in political détente, military détente lags markedly behind. The arms race has even intensified. Designed to deter and uphold high fighting readiness, military strength tends to develop and grow irrespective of transient political gestures. The outcome is an imbalance between the two wings of the arms control exercise. The military assumptions of arms control tend constantly to undermine and upset their cooperative postulates. There are limits to the mastery of coexistence and relations of partnership, while hazardous threat systems are simultaneously enhanced.

Secondly, one of the central notions of arms control - strategic stability - evades measurement or even any approximate valuation. Stability and balance in military affairs are very vague concepts: metaphors introduced into the strategic vocabulary from mechanics of dead substances, where behaviour is regular, easily observable, and well measurable. In strategic thinking, on the other hand, stability and balance relate to a thousand dimensions and variables, both material and human, interconnected and intermeshed in a highly complex way, and difficult to assess exactly. It relates to equipment, planning, and human behaviour, i.e. problems of technological, economic, political, doctrinal, and psychological nature. Moreover, there are few stable and static elements in the strategic equation today, in times of intense political change, systemic transition, and technological revolution. To apply the stability metaphor in lieu of a dynamic international reality is to invite errors and blunders.

It is, then, rather loose talk, devoid of precise meaning, to set goals of "parity" or "essential equivalence" in the U.S.-Soviet strategic equation. The more so in conditions of large structural force asymmetries stemming from heterogenous geopolitical exigencies, different security requirements, divergent doctrinal approaches, and discrepant technological capabilities. It is easy in such circumstances to sham "missile gaps" and argue for more and more armaments. Actually,

the "essential equivalence" concept has served to invigorate the arms race and has contributed to pushing up armaments to ever higher levels of military 'parity'.

Thirdly, most serious flaws are manifest in the doctrine of deterrence, which is an essential part of the arms control philosophy. Deterrence is not only morally detestable in its genocidal vengeance aspect, but is counterproductive as far as the dynamics of the arms race are concerned. Although, according to the basic logic of deterrence in the mass retaliation version, a limited number of strategic nuclear warheads should be sufficient to deter the enemy, it turns out in practice that military "sufficiency" actually knows no limits. In the beginning of the sixties deterrence sufficiency was calculated in the United States to be 400 strategic nuclear warheads, i.e. about two for each Soviet city over 100,000 inhabitants. The amount of strategic nuclear warheads in the United States arsenals has grown in the meantime over twenty times the above figure, and there is no halt in the further stockpiling of new deterrence weapons. The recent shift in emphasis to counterforce strategies, focussing more on quality than the quantity of nuclear arms, has opened a new Pandora box. Military Research and Development (R&D) got a formidable stimulus to develop more advanced and efficient missiles, and the mix of different missile characteristics adding to weapon modernization - such as high accuracy, better guidance, larger throw-weight, superior penetrability, wider range and greater speed - is almost infinite. It hus follows that deterrence tends to press armaments dynamics beyond even the limits of strategic rationality.

At a certain point perfection of counterforce capability channels into a race for "first strike" capability. It may then be sufficient that one of the powers, even without achieving first strike capability, but perceiving a chance of winning, or fearing a preemptive attack from the adversary, it actually may decide to strike first. Moreover, with the growth of the nuclear club, deterrence calculations become almost futile,

both because of the multiplicity of actors and the diminution in the rational behaviour of its many leaders. All this inclines to the conclusion than in the fast changing international environment today, deterrence is increasingly losing its assumed calculated strategic validity. Further adherence to the deterrence doctrine may more and more prove deceptive and spell disaster.

Fourthly, the above inconsistencies and flaws in the concept and substance of arms control have a devastating impact on the negotiations process. They reinforce each other and tend to frustrate the efforts of the negotiators. The long-term trend is for obstruction even of limited steps. Though the United States and the Soviet Union may come to the negotiations table willing to accommodate armaments and levels of forces so as to preserve their mutual security and international position as understood by actual strategic analysis, they soon find themselves locked in sharp dispute about the means and ways to compromise. Underlying this clash are: a) divergent security requirements and assessments, b) asymmetries in force structures, means and capabilities, and c) the atmosphere of secretiveness which breeds suspicion and impells rivalry.

One of the basic divergencies at the negotiations table, deeply rooted in history, military tradition, and strategic doctrine, is the Soviet preponderant concern with sufficient quantities of arms, in contrast with the preoccupation of the United States to preserve their lead in quality. As they are lagging behind in the highest military technology, the Soviet military leaders are keenly interested to compensate for the gap by higher quantititive levels. The only accommodation possible, then, is moving upwards both in quantity and quality - a politically ever more embarrassing proposition. The corollaries are far-reaching. Because of the centrality of strategic considerations and military issues involved, the negotiations tend to enhance the position of the military establishments, and in the process, military desiderata tend to prevail.

In the short history of arms control negotiations, a number of techniques have evolved - some of them taken over from abortive

past disarmament talks - which contribute to exacerbate the dynamics of armaments. The most well-known of such techniques are: a) the bargaining chips practice, which consists in the development, parallel to the course of negotiations, of new weapon systems or highly advanced arms intended initially to force the hand of the adversary in the talks, but finally never bargained away and incorporated in the end as common assets in the new accords (the best known example is the case of the Multiple Independently Targetable Re-entry Vehicles (MIRVs) developed first as a bargaining chip in the SALT talks but later included as the central weapon in the SALT inventory), b) the displacement device consisting in compensating certain armaments measures or particular arms done away by arms control with other resources, on a higher level of armament techniques (the shift of nuclear weapon tests from the atmoshpere to the underground is one example, the compensation of quantities by higher quality is another), c) the symmetry method consisting in accords of formal symmetry by pushing up arms levels to the assumed strength of the more advanced partner and then starting from the new common floors as a basis to negotiate yet higher ceilings (SALT I and SALT II contained just elements of such deals).[15]

Obviously, in such circumstances, negotiations become more and more intractable and the results produced do not even satisfy the goal of a prudent mutual steering of armaments.

3. Armament Dynamics and Disarmament

To be effective and halt the arms race, move to the reduction of armaments and bring about disarmament, arms control must strike at the root causes and the dynamics of armaments. This is a big order, but is the task not feasible?

There are, of course, socio-political and structural constraints which stand in the way of radical departures. But one basic feature common today for armaments in all countries should make it possible to try and impose rationality on this insane process. This is the fact that, basically, armaments are now steered by governments, programmed and executed by state bureaucracies. Though private interests are still profitting and may sometimes have a strong say in various countries, and another set of vested interests may apply in other countries, the present situation is different from a generation ago, before the advent of the nuclear age. Armaments, weapon procurement, and the arms trade are today fully under government control, and this makes the responsibility unmistakable. An enlightened public opinion should in a democratic process, at least theoretically and in a great number of countries, be in a position to influence events.

The question then is: what are the characteristics of contemporary armament dynamics? Which are the most sensitive areas in need of control?

Two basic mainstays of armaments today lie in the domain of politics and technology. Armaments occupy the top of an interconnected triangle relying at its base on a number of political variables in one corner and technological ingredients in the other. To undercut the dynamics at the top of the triangle, the modus operandi at the bottom pillars must be changed.

3.1 The Political Domain

General armaments dynamics in the political domain may, essentially, be explained by the traditional action-reaction mechanism - a process in which adversaries, driven by suspicion, fear, and rivalry, tend to react and overreact to moves in the opposite camp, thus setting in motion a chain reaction of armaments escalation. An important integral part of this dynamics is the atmosphere of deep secrecy. Imposed as a general rule of behaviour in military affairs, breeding mistrust and alarm, secrecy becomes a formidable destructive power. Furthermore, a number of specific elements in the political superstructure contribute to reinforce the action-reaction dynamics. These lie mainly in the sphere of military doctrine and ideological postures which tend to produce unreal, exaggerated, and deceptive enemy images.

The core of the disease today is incorporated in the deterrence dogma - a theory and conviction which assumes constant mistrust and, by definition, requires steady perfection of all sorts of weapons and, in particular, weapons of mass destruction. Deterrence generates autistic dynamics which sustain conflict constellations and block the way to genuine détente. Without an effort to free humanity and human relations from such threat postures and systems, from a mentality of jungle laws, it may be difficult to advance to any lasting relaxation of tension and disarmament.

From this point of view, perhaps the most important precondition of change is greater openness in questions of security. There are many ways to foster openness. Some of them are known as confidence-building measures and include a variety of propositions from greater openness in military budgeting and visibility of security arrangements, to bilateral and multilateral control systems in sensitive areas of armaments. What is needed is political will and a readiness to take some risk for peace against the greater risk of war.

In fact, such risk-taking must not touch on essential security provisions. One of the strategies, for instance, could connect moves to greater openness with unilateral reciprocated initiatives.[8] Instead of intricate negotiations to regulate mutual advances in armaments, the superpowers could initiate a chain reaction of arms reduction by gradually cutting back certain items of their armoury, in a continuing process of unilateral initiatives by one party and reciprocation by the other. The arsenals of the superpowers are today so overloaded with weapons of different sorts, the force levels are so high, and the overkill capabilities so large that, even adhering initially to deterrence doctrines, the advance to disarmament by successive unilateral and reciprocated initiatives could proceed without jeopardizing at any single stage the security of the parties.

Progressive cuts and visible steps aiming to lower military postures, with no essential harm to security, could be undertaken in military expenditures, in quantities of certain arms, by replacing offensive weapons with arms of a more defensive nature, by halting the development of certain weapon systems thought to be perilous and destabilizing, by disengagement moves in sensitive areas of military contact, by restraint in arms trade, by declaring moratoriums on certain weapon tests, or deployment of novel weapon systems, by self-denial acts such as 'no-first-use' commitments, etc. The diversity of the strategic scene, the multitude of weapon systems, the spread of arms in space and time, and a variety of functional elements in the military build-up open wide possibilities for such

initiatives. Imagination in security matters must be shifted from war scenarios to enhancing security by reduction of arms.

One may add that exemplary moves could well be undertaken jointly by the United States and the Soviet Union to prove their sincerity and invite cooperation in efforts to halt the arms race. Such steps could be started by a comprehensive nuclear test ban or by demonstrative restraint in arms sales. The superpowers' prevalence in nuclear weaponry and military strength is so big as compared to the other members of the nuclear club that they do not need to fear any impairment either of their security or of their general lead in military affairs by starting first with measures aiming to generate universal restraint. On the contrary, their very security might be enhanced by a slowing down and cessation of the armaments race.

An important feature of the strategy of unilateral and reciprocated initiatives is the activation of public opinion as a socio-political force behind disarmament measures. Generation of political will at the centres of power for the reduction of armaments is a very intricate process and may require constant pressure from a vigilant public. Yet today the climate surrounding the disarmament debate is marked by considerable complacency. Public opinion seems to have largely lost its interest in arms control negotiations. It has been lulled into a feeling of false security by the esoteric diplomatic half-truths which systematically misapply terms like "restraint" or "limitation of armaments" to denote actual steering of armaments build-ups. It has been thrown into inattention and inaction by the complex technicalities in the arms control talks. Unless public opinion is aware of the actual realities in armaments and disarmament, and unless this opinion is brought into active play for the cause of disarmament, the prospects for change may not be promising.

There are good opportunities in 1977 to initiate a broad discussion on problems of armaments and disarmament. The advent of a new administration in the United States, the expressed eagerness in Moscow to achieve tangible results in arms control

negotiations, the change of leadership in China and, last but not least, the decision to hold a special U.N. General Assembly session in 1978 devoted to disarmament - all these events and circumstances are good opportunities both to intensify the educational effort and to try to infuse a new spirit into the disarmament debate.

3.2 Problems of Technology

The other mechanism of the armament dynamics which needs special attention is the race in military technology. Modern military technology, innovated and impelled by the second technological revolution, is today a mighty driving force behind armaments. The political factors, as reflected in the action-reaction phenomenon and the deterrence doctrine, relate mainly to the sphere of international dynamics. On the other hand, the technology drive is substantially of an internal nature - autistic and generating its own momentum.

It is the mode of operation of military research and development (R&D), and its size, resources, and inert properties which cause a dynamics of special intensity. The very fact that nearly half a million scientists and technicians, a quarter of the world's scientific manpower, with a budget of more than 30 billion dollars at current rates, are devoting all their skill and efforts to improve existing and develop new weapon systems, may give en indication of the push behind the escalation of armaments. [9] The huge military R&D establishment, today eating up 10-15% of military budgets, exerts an extraordinary pressure on the arms race. Moreover, an organic web links military R&D to other vested interests in armaments - the military, the armaments industry, and state bureaucracy. President Eisenhower's military-industrial complex grew into a military-industrial-technological-bureaucratic complex.

There is much evidence to show that internal pressures in armaments are today greater than external mechanisms such as the action-reaction phenomenon. This may, among other things, explain the fact that despite political détente there has been no halt in the arms race. But there is interaction and fusion of

of external and internal dynamics, the element of competition expanding from the international to internal levels. Impelled by military R&D, competition has encompassed the different services - land, navy, and air force - centres of research and scientific disciplines. Programmed to a drive for modernization and innovation, military R&D is never satisfied with current achievements. It constantly reacts to its own exploits and continues the thrust to new frontiers. Its push and impetus become autonomous, less impelled by outside orders than by its own vigour and regularities.[10]

Of the regularities, two are of special importance: a) the long lead-times for the development and production of modern weapons, and b) the follow-on imperative.

The long rhythm from the invention and development, to production and deployment of new weapons and weapon systems, usually spreading over a period of up to 10 years, secures for military R&D constancy, continuity, and permanency. At the same time, the long-lead times tend to interfere with efforts of planning in arms control. The two cannot be coordinated and synchronized. Whereas negotiations refer to existing weapon systems, new arms produced by military R&D tend to make these weapons obsolete and irrelevant. Agreements reached with regard to old weapons are made almost worthless by the emergence of new arms technology. The examples of the U.S. long-range cruise missiles and the Soviet Backfire bomber, developed at the time of the SALT negotiations and becoming stumbling blocks to SALT II, after the initial accord in Vladivostok, are a good case in point. The general outcome is that arms control cannot cope with the pace and pressures of new technology.

The other regularity in military R&D - the follow-on imperative - is a variant of the so-called Parkinson's law which deals with the spontaneous and impetuous growth of institutions. Being a very crucial branch of armaments with highly specialized manpower, military R&D must be kept on a high level of constant readiness. Production lines must be kept open. Employment cannot be cut down; in fact it has to grow, both because of new

fields of research and the pressures of development. Military R&D tends to swell and expand incessantly, beyond even operational requirements.

A dangerous interaction occurs. New weapon systems developed by military R&D enrich the instrumentality of general staffs, while imagination then let free in the centres of strategic planning generate new orders for the researchers. A mutual urge.

The rise of military R&D in modern times has added new dimensions to the armaments dynamics and no serious effort to halt the arms race can overlook this state of affairs. As long as crucial parts of military R&D are not brought under control, one cannot possibly expect success in disarmament.

Admittedly, this is a difficult task, and cannot be resolved with one stroke. But an intensive search for solutions is imperative while initial steps, some of them even crucial, could be taken straight away. Such steps concern especially the ban on all testing activities which are easily observable and verifiable with national technical means of control. Most important would be a comprehensive nuclear test ban and the prohibition of testing of long-range missiles.[11] An agreement in these domains would limit military R&D considerably. It would also be a contribution to disarmament of far greater importance than any of the arms control agreements concluded in the past two decades.

In sum, the simultaneous focus on political and technological issues which shape the environment and impel the dynamics of armaments, with a view to change directions, impose control, and infuse commitment for genuine disarmament, might transform the horizons of arms control and disarmament. A climate could then be created for renewed consideration of general and complete disarmament.

Conclusions

This paper has argued for the need of radical new departures in arms control and disarmament. Arms control as implemented in

recent years has proved to be counterproductive. Never in history have armaments spread with such giant strides as in this very period. There is good reason to be concerned with this development and, first of all, with the enormous destructive military potential in the hands of the United States and the Soviet Union. Yet solutions to their and the world's security cannot be sought in upward parities and a rush to ever higher levels of deterrence. Such military build-ups only increase the vulnerability of all concerned. They create less security both for the superpowers and the rest of the globe.[12] They contribute also to what strategic analysts refer as destabilization of the military balance.

The stalemate and crisis in arms control is no secret anymore. Some arms controllers who still adhere to old concepts propose remedies ranging from new sweeping goodwill declaratory accords, to a turn towards military accommodation on the highest levels of counterforce technology. Such steps would obviously only mean deeper submersion into the quagmire of armaments. They would transform crisis into perpetual exposure.

Improvement can only come through a change of direction. Arms control must be given new meaning and content, consistent with the goal of disarmament. Some members of the state bureaucracy in East and West may not yet have grasped the fundamental change in human history with the advent of the nuclear age. The fragility of human society has increased infinitely. Nuclear energy and the achievements of the second technological revolution may be applied for good or bad. But nuclear war may literally destroy mankind. The remedy in such circumstances cannot anymore be sought in war games as tried by our fathers. There is a need for a new world order built, among other things, on general and complete disarmament.

One of the greatest paradoxes of modern history is the fact that the goal of general and complete disarmament was embraced by all nations and was thought plausible and feasible almost two decades ago, with the Cold War still in the air; whereas today, in the atmosphere of détente, this goal is met with

scepticism, as an utopian dream almost. Yet the blueprint for general and complete disarmament, as inscribed in the 1961 U.S.-Soviet accord on Agreed Principles for Disarmament Negotiations, known as the McCloy-Zorin agreement, is a very sober and prudent document.[13] It may be that further advance to the implementation of this agreement was upset by a specific transformation of the international scene, the rapid accumulation of new weaponry, and a lack of courage and imagination at the centres of power. With a better historical perspective, telling experience, and deeper understanding of the issues, it is time to halt, reconsider the dilemmas before us, and opt for human rationality.

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For Prof. H. York with apologies for possible inaccuracies EB

The Technology of Nuclear Warfare

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ABSTRACT

The present technical status of the nuclear weaponssystems and of the systems for their delivery is explained. All these systems have made tremendous progress since the 1960s. Available destructive power now is literally millions of times larger than at the time of Hiroshima. Moreover, technical progress has had, especially through the MIRV principle and the cruise missile, a destabilizing influence and threatens the equilibrium of terror. New strategic doctrines for winning rather than preventing nuclear war are developed. According to the counterforce strategy the retaliation capacity of the opponent is to be destroyed by a surprise attack. Moreover, plans for the tactical first-use of nuclear weapons have been accepted.

In a nuclear conflict, the commanders-in-chief are overburdened by the need for ultra-urgent decisions. As a consequence tendencies in the direction of increasing automatization become ever more conspicuous. In the extreme case, decisions may be entirely left to machines, and man would not any more be included in decision-making. The increasing automatization leads to further escalation of insecurity for the whole world. A solution cannot be found on the level of technology, but only on that of practical peace policy.

1. Introductory Remark

Ultimately, this article is based on a public lecture held in 1973 in the Faculty of Catholic Theology of Vienna University within a cycle "Possibilities of Peace". The present version has been updated to 1979. The author is an active scientist, but not a weapons or arms control expert. Hence it may be inevitable that here or there a thing has been misunderstood or misjudged, though every attempt has been made to avoid this. Yet the broad lines and trends are clear. Naturally, all data are taken from the open literature, as quoted.

2. Hiroshima and Nagasaki

On August 6th, 1945, a bomb containing 60 kg of uranium 235 (1) was dropped, without previous warning, on Hiroshima. Three days later, Nagasaki was destroyed by a bomb containing 8 kg of plutonium 239 (1). Here the number of victims was somewhat smaller, as the town is situated in hilly country and had fewer inhabitants. According to the latest Japanese estimates, the number of dead in the two towns taken together may have been 250.000. In Hiroshima alone it was 140.000 out of a population of 360.000, i.e. nearly 40 % (2). The uncertainty is great as there had been, in the chaotic conditions in the Japan of 1945, an uncontrolled mass influx of people into towns previously intact.

The effect of the uranium and plutonium bombs (3) is mainly due to the fact that in nuclear fission 17 million times more energy, per unit weight, is released than in the explosion of the strongest chemical explosives. One of these is trinitrotoluene (TNT, trotyl), which was widely used in the First and Second World War. Nuclear fissions are induced as a chain reaction that requires less than one millionth of a second (microsecond) (9). The reaction is transmitted from nucleus to nucleus by the neutrons that are released in fission with speeds of some 10.000 km/second.

The heaviest chemical bombs of the Second War contained about 10 tons of TNT. The explosive power of the Hiroshima bomb corresponded to that of 14.000 tons (= 14 kilotons, Kt) of TNT (1,9), the power of the Nagasaki bomb to 20 Kt (10). Thus the power exceeded that of the strongest bombs used before more than a thousandfold. About two thirds of the energy released appeared as mechanical energy of the pressure

wave, one third as thermal energy of the heat radiation, and 6 % as energy of the "ionizing" radiation, i.e. of radiation as produced by radioactive substances and X-ray tubes. The particles of such radiation, including particles of electromagnetic radiation ("photons"), carry enough energy to "ionize" atoms, i.e. to deprive them of electrons. The number of dead was distributed over these effects in a ratio of about 20 : 60 : 20. Thus heat radiation was most effective. However, because of overlapping a clear-cut distinction is not possible.

In Hiroshima, the explosion was triggered by an automatic mechanism 600 m above the "hypocentre" ("ground zero"). This height had been chosen to maximize the action of blast and heat (9). At the centre of the explosion, the initial pressure must have amounted to millions of atmospheres. Concrete buildings were destroyed up to 1 km, solid brick buildings collapsed up to 1,5 km, and glass broke up to 13 km from the hypocentre.

During the explosion the material of the bomb reached a temperature of many million degrees, similar to that of the interior of the Sun. The energy of the heat was at first given off mainly as soft (long-wave) X-radiation, i.e. as ionizing photons. The X-rays were absorbed easily by air near the place of the explosion, and the air was thereby heated up to a "fireball". The temperature at the surface of the fireball still exceeded that of the surface of the Sun, though it was much less than that of the interior of the Sun. The fireball emitted intense ultraviolet and visible light. Light also consists of photons, but because of their lower energy, per particle, they do not ionize any more. Nevertheless, light transfers energy to materials. The number of the low-energy photons was now much more than that of the initial, high-energy, photons.

Owing to the absorption of this intense radiation even stones were melted superficially; near the hypocentre, their surface temperature often reached 3500°. However, stones were protected already by persons standing in front, so that the contours of such persons remained permanently imprinted into the stones; before the person was annihilated, the heat radiation had ended. At larger distances dark patterns (for instance, on women's dresses), which absorbed radiation more strongly, burned themselves into the skin. Eyes that looked towards the exploding bomb were damaged; at

smaller distances, the people were permanently blinded.

Timber, paper and other combustible material burst into flames. Dry newspaper caught fire at more than 4 km. Owing to the resulting conflagration the air rose so that more air was sucked in from the side, and the fire was intensified. A socalled firestorm resulted, similar to that observed before in other Japanese towns as well as in Hamburg and Dresden. This meant death for further large numbers.

Among the ionizing rays emitted directly by the nuclei of the fission products the gamma-rays were particularly effective. These are also photons, but each particle carries hundreds of thousands times more energy than a particle of the ultraviolet or visible light radiation, and also many times more energy than a particle of the soft X-radiation mentioned before. During the first seconds after the explosion, the intensity of the ("prompt") gamma-radiation corresponded to that of millions of tons of radium. In cancer hospitals, where radium is applied, already milligrams of the element are treated cautiously.

Gamma-radiation is absorbed by air fairly strongly, though less so than the soft X-radiation. Hence the intensity of the gamma-rays decreased more strongly than with the inverse aquare of the distance. Even so, in Hiroshima the gamma-radiation was already by itself lethal up to 1200 m from the hypocentre for persons exposed during the first minute.

Further important radiation effects were due to the fast neutrons from the exploding bomb. While neutrons, in contrast to high-energy photons, e.g. gamma-rays, do not ionize directly, they transfer energy to atomic nuclei. The nuclei thus propelled are, because they are electrically charged, strongly ionizing. So in the end the effects of neutrons resemble those of gamma-rays. They even exceed them, as detailed investigation shows, per unit energy absorbed.

Ionizing radiation is not painful. Indeed, ordinarily exposure is not noticed at all. Surely the reason is that the ancestors of man met only unimportant intensities in Nature so that they had neither opportunity nor grounds for the development of warning sensations. Generally the effects of the rays arrive relatively slowly. After exposure to a lethal dose, death follows after days or weeks, in some cases even after many years only. But with extreme

doses, the nervous system is paralyzed within minutes. We shall later return to the extreme doses: produced, by means of the socalled neutron bomb, on the battlefield.

The effects of ionizing radiation include damage to the blood-forming tissue, leading to anaemia, incapacitation of the digestive tract and paralysis of the production sites of antibodies so that the organisms is defenceless even against normally harmless infections. After many years, cancer may appear, especially as leukaemia. Unborn children, whose developing tissues are particularly sensitive, suffer malformations. Also the succeeding generations are damaged. Mutations of the genetic material must still lead to handicapped individuals after thousands of years.

Ionizing radiation comes not only from the place of the detonation, but also, later, from dispersed radioactive fission products, like radioiodine or radiostrontium. Most of these products slowly fall to the ground. In Hiroshima this radioactive "fallout" was unimportant, as the fireball, as a consequence of the height of the exploded bomb, had not touched the ground. Hence the fission products were pulled up by the hot air, were distributed over a large volume, and settled only slowly and in dilute form. Meanwhile their radioactivity had in part decayed.

The situation is different when the fireball touches the ground and evaporates soil and rock. The vapours mix with the fission products, and after cooling relatively large grains fall down rather quickly, and near the hypocentre. Hence an intense radiation carpet is formed. This may endanger humans directly. Moreover, these areas cannot be used for farming (8), and there is the further problem how the starving population can be prevented from eating contaminated food. (Should it be prevented?). The degree of danger from fallout will greatly, and irregularly, vary from place to place. It cannot be estimated without instruments, but even the reading of the instruments and the interpretation of the data are no easy matters. The population of Bikini, where heavy fallout was produced in tests in 1954, had to be removed from the island a second time recently, as a consequence of increased incidence of cancer (11).

In addition to the radioactive fission products, radioactive substances are produced by activation of environmental material by the neutrons. Thus radiocarbon, half-life 5700 years, arises in

large quantity in a nuclear reaction of the nitrogen of air with neutrons. The radiocarbon has no military importance whatever, but it will gradually be taken up by organisms and will damage their hereditary material for tens of thousands of years.

3. Hydrogen Weapons

On technical grounds, the explosive power of uranium of plutonium weapons, e.g. bombs, cannot be increased indefinitely - perhaps, with a great effort, to 500 Kt equivalent (1). To improve matters, "hydrogen weapons" were developed that contain heavy hydrogen ("deuterium"). From 1953, they were tested both in the USA and the USSR, and they were available soon in rather large numbers. Technically, their explosive power has no ceiling. Moreover, the increase of the power, by addition of more deuterium, etc. is not expensive. Per unit explosive power, a hydrogen bomb of 100 Kt costs only one hundredth as much as a chemical bomb (8). A bomb of 100 megatons (Mt) - of 100 million tons TNT equivalent - costs only twice as much as a bomb of 100 Kt (12,14). That much TNT would weigh as much as 16 Cheops pyramids.

The principle of the hydrogen weapons is similar to that of energy production in the Sun. The energy likewise comes from the fusion of light atomic nuclei, but the weapon does not burn quietly (steadily). As soon as part of a suitable mixture of light atoms, which must include deuterium, is brought to a high enough temperature, it ignites, and the "thermonuclear" reaction begins. Usually ignition is achieved through the heat of fission of uranium or plutonium contained within the weapon. This fissile core acts as a detonator. More recently attempts are being made to use laser radiation (intense light) for ignition.

For the characterization of a hydrogen bomb we choose one with an explosive power of 10 Mt *), 700 times stronger than that of

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*) H.York (4) explained why explosive power was fixed to 1 Mt or 10 Mt, etc. There is no technical or military reason. These are nice round figures. We also talk of millionaires, but not of people owning 1,400.000 currency units.

Hiroshima. E.g. the American long-distance rockets (ICBM - Intercontinental Ballistic Missile) "Titan" have at least 5 Mt (15,16,17). The Soviet long-distance rockets SS-9 may carry 20 Mt each (15,17, 18,19); they account for one half of the total destructive power of the Soviet strategic arsenal (17). For comparison: all bombs dropped by the Allies during the whole Second World War together had only 5 Mt.

The radius of mechanical destruction increases with the cube root of explosive power (20). Hence with a 10 Mt bomb this radius exceeds that in Hiroshima 8 fold. Consequently brick houses would be destroyed as far as 12 km. The area affected increases with the square of the radius, and brick houses would collapse on about 450 km^2. This area might include a town with millions of inhabitants.

The effect of heat radiation increases directly with the energy of the explosion and decreases a little more strongly than with the inverse square of the distance. As the Hiroshima bomb ignited paper at 4 km, a 10 Mt bomb could do this at 70 km. Provided there were enough combustible material the firestorm might extend over an area with 30 - 40 km radius.

The prompt gamma-radiation of the 10 Mt bomb would be lethal to 4 km. The extent of the fallout would again depend on the construction of the bomb and the circumstances of the delivery. Further away from the hypocentre, the effect of the fallout is greater than that of the prompt radiation (21).

Enormous amounts of fission products and of fallout are obtained from the three-layered "dirty" weapons that surely form a large part of the existing arsenals. Some such weapons were ignited several times in the atmosphere in the 1960s. They contain not only the detonator and the substrate for the thermonuclear reaction, but also - outside - a layer of the uranium isotope 238. This heavy substance is an excellent tamper, but at the same time it also contributes greatly to explosive power. While uranium 238, in contrast to uranium 235, cannot maintain a chain reaction by itself, its nuclei nevertheless undergo fission with the fast neutrons from the first two layers. Uranium 238 is a cheap waste product in the production of uranium 235 from natural uranium, also for the purpose of fuelling nuclear power stations. York (22) gives the rough rule that for every 2 Kt of explosive power 1 square mile will be bathed in lethal levels

of fallout within hours after the explosion.

Recently it has become possible to test hydrogen weapons in the "laboratory", or, rather, in suitable buildings (weapons simulation). This is done by igniting with laser radiation rather than through the fission of uranium or plutonium. In this case, the explosive power can be limited by miniaturization. The installations are used to test radiation effects on military or other objects (23). For testing, enormous X-ray generators (weight 7000 tons) and generators of intense rays of charged particles have also been built (23).

4. The Size of the Strategic Arsenals

We have sketched the properties of the nuclear weapons during the 1960s. How many weapons did exist, and what were the means of delivery?

1) The Strategic Air Command (SAC) of the USA has 630 aircraft (B-52, etc.), incidentally also to be used subsequently in Vietnam. Every one can carry 50 Mt or more of bombs (24,25). Thus already 10 % of this fleet, provided they can penetrate, can throw bombs equivalent in power to 100.000 Hiroshima bombs (26) *). To be safe from surprise attacks, part of the fleet, with bombs, is in the air all the time. In the Soviet Union, bombers play a subordinate role only (15,27,28,29, 30,31). The reason is that bombers are expensive, and they need bases not too far from the target areas.

2) The ICBM weapons of the USA include the Titan rockets with 5-10 Mt each (16,17,18). They are operated with liquid fuels (32) that require a not inconsiderable time before use. In contrast, the Minuteman rockets with smaller warheads each are driven with solid (stable) fuel, and are ready for action within 1 minute (33). Every missile lies in a separate underground silo, which can be used only once. The missile is guided in flight by an inertial mechanisms (34).

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*) The esteemed readers are invited now to pause and to think again. York's statement, here given, implies that the destructive force carried by SAC alone is 1 million (!!) times that of the Hiroshima bomb. The force of the strategic (!) and tactical rockets or of other tactical weapons is not included.

It is targeted already in peace time. Typically, the targets consist of big towns with large (and unsuspecting) populations.

3) Submarines equipped with nuclear engines, therefore capable of prolonged dives, roam the oceans. Every US boat ("Polaris") has 16 launching tubes for solid-fuel rockets (35) that are brought into position with compressed air. These missiles are also targeted, but clearly the movement of the boat must all the time be taken into account. This is no doubt done by computer. When submerged, the boats are practically undetectable from afar.

For comparison, more recent data about strategic weapons (8,27, 36,37): the USA have 414 long-distance bombers with 4-24 bombs each, at home on 46 airfields of the SAC. Moreover, there are in USA 1054 ICBM and 656 missiles on submarines. There is a number of ICBM base areas; each Minuteman field has several thousand square miles and contains 150 - 200 silos (8). The USSR has 140 long-distance bombers, 1452 ICBM and 812 missiles on submarines. Be it noted that many of the American, but few of the Soviet missiles have been MIRVed, i.e. equipped with a multiplicity of warheads (see below). Thus the total number of strategic warheads is about 12000 in the USA, and 4400 in the USSR (17).

The growth of the arsenals has not reached a limit. For instance, for the USA about 14500 strategic warheads are forecast for 1985 (17, 38). Moreover, the figures do not take into account the tremendous improvements in quality since the 1960s. We shall refer to them later.

5. Defence Against Strategig Nuclear Weapons?

To which extent was and is defence possible not only against strategic bombers, but also against intercontinental missiles? Already up to 1970 about 30 billion (10^9) dollars had been spent on systems for antiballistic missile defence (ABM) in USA alone (39,40), but success was small. The difficulty is that the missile reaches not only a height of 1000 km, but also a speed of 30.000 km/hour, i.e. of 8 km/second, many times as much as aircraft (41). Moreover defence makes sense only if a very large part of the enemy missiles, almost all of them, can be shot down. In contrast, during the Second World War defence was considered effective if 10 % of the attacking force were shot down.

From time to time, fantastic projects were put forward. For instance, according to project "Bambi" (note the cheerful name - Ballistic Missile Booster Interceptor) a fleet of armed satellites should all the time circle the globe, and they should automatically destroy the enemy rockets by means of missiles with hydrogen warheads immediately after their launching (42). At that time the enemy rockets would still be within the atmosphere so that the pressure wave could affect them. Clearly project Bambi has problems that are not inconsiderable. For instance, the circling satellites must control the whole enemy area all the time.

More serious is the system derived from the starting point "Nike-Zeus" (43,44). According to the "Safeguard" system (45,46) hydrogen weapons are directed against the enemy ICBM which have been under way for a time and therefore are now in empty space. The enemy missiles are supposed to be destroyed by means of the ionizing radiation emitted by "Spartan" warheads that are exploded near the enemy missile. Pressure waves cannot form in empty space. On the other hand, ionizing radiations are not absorbed there, and therefore their range of action is large. The defending missile must approach the enemy missile sufficiently, notwithstanding the enormous speed of the latter. Steering takes place through computers into which radar information about the position of the missile is fed all the time. After reentry into the atmosphere the enemy missile can still be hunted with "Sprint" rockets. They are so fast that they overtake bullets from machine guns within 3 seconds (44), and also carry nuclear explosive (4). Explosions of hydrogen weapons above one's own country are, of course, unpleasant, but they are still to be preferred to explosions in the target area.

The chances of success are modest. This applies especially under operative conditions where one may have to face not only a massed attack by hundreds of missiles, but also general confusion, even chaos. The radar installations would be saturated by the massive attack, and the problems would be sharpened by decoys and reflecting metal sheet. Furthermore the cost of such defence systems, if they are to have the smallest chance, are intolerable even for the rich USA. Hans Bethe as well as J.von Neumann have called ABM systems practically hopeless (47). Nevertheless, a giant defence centre ("Safeguard") was built up near Grand Forks in North Dakota (44).

6. Tactical Nuclear Weapons

The original and principal goal of nuclear weapons is evidently strategic and consists in the massive devastation of enemy territory. But again and again thought has been given to tactical uses (48). For instance, the idea was supported by Kissinger in 1957. The "father of the hydrogen bomb", Teller, was also sympathetic, and Secretary Dulles took the idea up. However, nuclear warfare limited to tactical use presupposes agreement, written or tacit, between the enemies. Thus nuclear war would become a kind of tournament where neither side must disobey the rules. This idea did not seem credible, and so Kissinger withdrew. Nevertheless, the forces of the great powers have been equipped with tactical weapons (49,50) so that they could be used in a given case, for instance, during strategic nuclear war.

In 1974, the new US Defense Secretary, Schlesinger, revived the plan of tactical nuclear warfare, and made it a component of the official military doctrine (51,52,53). He emphasized in statements that the USA had never pledged no first-use of nuclear weapons. On the contrary, the USA reserve the right to meet with nuclear weapons an attack with conventional weapons. Incidentally, tactical nuclear weapons, once they are operative, can also be used without previous attack with conventional weapons, or they can be applied for blackmail.

Is it credible that an enemy himself armed with nuclear weapons would remain within limits that appear appropriate and advantageous to the first user in answering nuclear blows? Barnaby, the Director of the Stockholm Peace Research Institute, SIPRI, pointed out that if conventional war leads to tactical nuclear war, then tactical nuclear war leads to strategic nuclear war (51). Clearly use that is at first limited will be answered in the same or in a stronger way, the response will bring further intensification, etc., until soon the nuclear arsenal will be used fully. "Limited nuclear warfare is simply not credible" (54). Disbelief in geographic or other limitations of nuclear warfare was also expressed by H.Brown (55), formerly a weapons physicist in Teller's Livermore laboratory, and Secretary for Defense since 1977.

An entire "family"*) of tactical weapons has been produced. Some of them (Honest John, Pershing, Lance) are delivered by rocket. They can be transported by road and cover the whole range up to 700 km (53,57). Artillery shoots nuclear weapons in shells at distances up to 30 km (1,53,57). Tactical application from aircraft is possible through free fall of weapons, by gliding bombs with television guidance (57), or through "SRAM" short-distance rockets (18,28). "ABM" (Atomic demolition Munition) produces craters and could block mountain passes. The typical explosive power of a tactical weapon may be several kilotons TNT equivalent, but some weapons reach several hundred Kt, or even megatons (21,50,58). Tactical weapons on ground, in part ready for immediately use, are kept in fenced-in igloos that in the case of American weapons are always guarded by American personnel (59). They are protected by mechanical locks and electronic switches that operate only on receipt of code words (53). Presumably the situation is analogous with Soviet weapons.

In 1966, R.McNamara stated that the USA have in Europe 7000 tactical nuclear weapons, and that they are located in 100 places (58,59,60,61). Schlesinger gave a similar figure for 1977 (60). Possibly at certain periods the number was 10.000 (53,62,63). The total explosive power of the American tactical nuclear weapons in Europe is said to be 460 Mt, corresponding to 30.000 Hiroshima bombs (58). According to some American sources, the number of Soviet tactical nuclear weapons in Europe is about half that of the American weapons, but others assume equality (50,58,60,64). 2000 American tactical weapons are said to be stationed in Asia (50,58). In the USA there may be further 10.000 tactical weapons in storage, and the total number of the American tactical weapons in the world may amount to 20.000 (50,58,65,66). In addition, there are, of course, the 12.000 strategic weapons.

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*) The weapons experts are gifted with a sense of humour and a cosy way of expressing themselves. They talk of families, and, as we shall see, of an Honest John. Bambi has been mentioned already. Meaning the part of the population that will perish within 2 months, they talk of a "60 days population response". In the accounts, 1 million dead appear as 1 megadeath, and the additional dead due to fallout are called "bonus kill" (56).

A sharp dividing line between strategic and tactical weapons is not possible. Thus enemy country may be attacked by medium range missiles or aircraft. This is a possible role for the FBS (Forward Based System) of the USA with 500 aircraft (16,29,30) in Europe, the weapons of which nominally are considered as tactical rather than strategic. Soviet medium-range missiles could no doubt reach all Europe (64,66).

Many authors have emphasized the danger in technical developments that facilitate the crossing of the nuclear barrier, the "firebreak", e.g. Scoville (67), the former scientific director of the CIA. Tactical weapons of low yield might be applied without the intention of starting a general nuclear war, and yet this may be the consequence. It would be particularly dangerous if the decision about their use were left to commanders in the field.

7. The Neutron Bomb

In addition to the original tactical weapons, acting mostly through pressure and heat, smaller weapons in the Kt range have become important in the context of the first-use doctrine. They emit energy mostly in the form of ionizing radiation (fast neutrons) and are known as "enhanced radiation weapons" or, colloquially, as "neutron bombs" (53,60,68,69). This change has been achieved by an increase in the share of the thermonuclear at the expense of the fission reaction.

Humans, e.g. soldiers, are intended to be exposed to enormous doses of radiation even at relatively large distances. Then the nervous system is paralyzed rapidly, and no further action is possible, though death does not follow until 1 - 2 days later. Experiments with animals are meant to show how long after exposure action is still possible (70). Protection, with heavy shields, against the radiation is hardly feasible, as soldiers must be mobile. Some observers show considerable delight in weapons that paralyze and kill opponents, but cause relatively little material "collateral" damage to property (61). General G.Keegan has expressed his regret that the neutron bomb was not yet available in Vietnam (71).

Large overdoses of radiation near the point of action imply, of course, doses that are still lethal, or at least injurious, over a very much larger area. In practice, the area affected will be of the order of square kilometers. The general population will be struck. There will be many civilian dead. Even larger numbers will be incapacitated, and damaged genetically (72).

8. Mutual Assured Destruction

According to the original military doctrine that fitted the technical situation in the 1960s it was impossible to prevent tremendous damage due to attack ("first strike"). But the country that was hit and devastated, certainly maintained the capacity for strong retaliation ("second strike"), as its weapons and delivery systems could be destroyed only in part.

An attack by several hundred missiles only, e.g., from only 20 submarines, against the USSR could kill 76 million immediately, and destroy three quarters of the industry (27,73). A total attack against USA could kill 100 million (8). Each Mt might kill 1 million people in Western Europe (64).

The threat of retaliation could, it was thought, deter a possible enemy from attack. In this way, a "nuclear equilibrium of terror" was established. Conditions were:

1) The launching systems needed for retaliation could not be damaged lethally by attack, and

2) The targets of retaliation could not be protected effectively.

This doctrine is known as that of mutual assured destruction ("MAD"). The world situation is characterized by the fact that prudent observers still prefer MAD to the alternative, namely, the "Counterforce Strategy" (29), to be considered later. This view has also been expressed by Brown in 1975 (55).

According to the MAD doctrine, none of the two powers could make an attempt to win the war after the nuclear exchange. Thus Kissinger wrote in 1962 (74) that "a counterforce strategy, designed to win a victory after we concede the first blow is an illusion..... The mere effort to develop such a force could not fail to lead to a

spiralling arms race and perhaps provoke a preemptive attack."

In connection with the perspective of conventional warfare after a nuclear exchange the physicist Panofsky (75) remarked that none of the generals or other experts know the things about which they talk. Some may have seen Hiroshima or the effects of hydrogen bombs in experimental conditions. But the consequences of massive destruction on the complicated tissue of a modern civilization has never really been studied. Hiroshima could be provided help. But what if a whole country is devastated? We depend on storage and transport of food. Electricity is made with fuel, but fuel must be provided with electricity. Medical services are calculated for normal needs when most people are healthy and work. But what will happen when the people, in the radiating ruins, are shocked, ill and starved? A concrete discussion, on the basis of an assumed explosion in New York or in a farming area, has been attempted by Mark (8).

According to the biochemist Glass (76) no humans would survive after nuclear warfare, not even rats, but rather insects. They resist radiation better, and they would not be threatened any more by their old enemies, the birds. The cockroaches would take over the remains of the dwellings of foolish mankind *).

What would be the effects on third countries? The National Academy of Sciences, charged by the Arms Control and Disarmament Agency (ADCA), has studied (77) the longterm effects of a major nuclear war on the Northern and Southern hemisphere outside the countries directly affected (8,78,79). It was assumed that about half the arsenal of nuclear explosive (10.000 Mt) was used in the Northern hemisphere. It was found that there may be climatic changes that cannot be predicted, but may well be important. The ozone layer that protects the organisms from the ultraviolet solar radiation would be largely destroyed and could reform only after years. Meanwhile burns due to this radiation and skin cancer would be common. Above all, the radioactive fission products would

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*) In his book, "The Legacy of Hiroshima", Teller suggested that the survivors of total nuclear war could reconstruct American civilization within a few years. Similarly Herman Kahn thought that after 20 million dead recovery would be possible within 10 years. In this context, see Lapp (l.c., p. 102).

contaminate the whole Earth and would concentrate here and there unforeseeably, like wind-driven snow. Although Handler, the Academy's President, declared that the aftereffects of the disaster would be so terrible that nobody would find a place to hide, the report was nevertheless accused of playing down the consequences (80). Perhaps the greatest weakness of the report is that it considered only the direct physical and biological effects of the detonations, but not the social, economic and political effects, due to the destruction of our complicated civilization and its infrastructure: hunger. illness and death for hundreds of millions, or even more, also among these not hit directly.

9. Role of Accident and Human Failure

Especially since the introduction of the intercontinental rockets in the 1960s concern has been expressed about the danger of an accidental outbreak of nuclear war. It has been felt that the ever increasing accumulation of weapons and transport systems must sooner or later lead to an unforeseen disaster. Up to 1977, at least 125 accidents with participation of nuclear weapons have been recorded in the open literature (81).

For example, a B-52 bomber with hydrogen bombs of 24 Mt crashed in North Carolina. It was found that of 6 mechanisms against the accidental detonation of the bombs 5 had been put out of action in the crash (82). Already up to 1968 the USA reported (50,83) a number of accidents, some of them abroad (Spain, Greenland). In Spain, it was likewise a B-52. In two of its hydrogen bombs the chemical, but not the nuclear explosive detonated.

Moreover, there is the possibility of a launch by mistake, i.e. by human failure, or, finally, by a Strangelove phenomenon - by an action of a madman. In USA alone 120.000 people have access to nuclear weapons or weapons material (50,84). Within one year, 3647 of these persons had to be discharged because of alcoholism or drug misuse (84).

On the other hand, there were many instances of false alarm, which in some cases could have led to nuclear war (83). Thus radio echoes from the Moon were ascribed to enemy rockets. At least twice

in 1971 it was wrongly assumed that American nuclear submarines had been sunk by enemy action. Some other events may not have been reported (83).

W.H.Pickering (85), the well-informed Director of the Jet Propulsion Laboratory of the University of California, wrote in connection with the problem of human failure: "It is a frightening prospect. Far more than being slaves of our machines, our very lives depend on the accuracy and reliability of a computing machine in a far distant country. The failure of a handful of vacuum tubes and transistors could determine the fate of our civilization". We might add: also the failure of a circuit within a man's brain. The man could be a President. A few days before Nixon's resignation, Schlesinger thought it prudent to instruct the military chiefs that they should not follow "unusual" orders of the President, i.e. the Commander-in-Chief (86).

Quite apart from the inevitable consequences of a nuclear explosion, due to a weapon from abroad, for those directly affected, it would be too much to hope that a state or its chief would take the disaster without counteraction that may well be stronger, even if the other country were not ascribed warlike intentions. Which President would let himself accuse of submitting to a new Pearl Harbour, and not paying back in kind?

10. Recent Advances in Strategic Weapons Systems

Since the end of the 1960s the equilibrium of terror, however precarious it was, has been threatened by new technical developments. Destabilizing influences have appeared and have provoked alarm among well-meaning experts (75,87,88).

A. Finance

About 30 billion (10^9) dollars annually are being spent in the world for military research and development (18,54,89,90,91), mostly no doubt in connection with nuclear weapons systems. (Expenditure in the USA, e.g., is 5 times as much as for medical research (54).) The military as a whole absorbed 334 billion dollars in the world in

1976 (92,93), and it may now well take in 400 billion. President Carter has proposed a military budget for 1979/80 of 126 billion dollars (94). US military expenditure is about 25 times more than assistance to developing countries (95); this assistance is, of course, still overshadowed by military-political considerations. The situation is even worse insofar as important new weapons programmes, e.g. the former spying programmes with U-2 aircraft, are not budgeted openly, but concealed elsewhere (96). Incidentally, the budget of the American secret services, hidden in the defence budget, amounts to about 6 billion dollars yearly (97,98).

B. Rockets and Antirockets

The warheads are being improved all the time. The trigger mechanisms have been further developed. While in 1945 (Hiroshima) the ratio of yield (tons TNT) to total weight (tons) was 3000, now a value of 1 million and more has been reached; clearly with chemical explosives this ratio must be below 1 (51,54).

Experiments are carried out with a "cold launch". As in submarines, the rockets are lifted first by compressed air. Thus no heat is developed inside the silo, and guidance is improved. Moreover, no heat shields are needed so that the missiles can be made bigger (13,99).

The precision of the missiles has made enormous progress. As long as the strategic rockets were to serve for retaliation only, modest accuracy was sufficient. Now they have become precision weapons even over enormous distances. This is due to the combined effect of improvements in materials, in the computers, in navigation, and in advanced guidance systems (100).

Mathematical analysis, partly by K.Tsipis, has shown that it is far more effective to increase the precision than the explosive power of the warheads (16,89,101,102). After the Second World War, the American military had at first declined a large-scale development of the strategic rockets captured in Germany, as the precision was too low. With a launch from a solid base, it was 35 km. This figure refers to CEP (circle, error, probable), i.e. the radius of the circle within which, on an average, one half of the warheads come down. But already in 1963 for ICBM an existing CEP value of 800 m

was quoted, a projected value of 400 m, an intended value of 200 m and a possible value of 100 m. The value of 400 m has practically been reached for the older version of Minuteman 3, range 13.000 km, and that of 200 m for Minuteman 3, mark 12 A (17,18,27,37,51,93,99, 103,104). A value of CEP as low as several dozen metres may be obtained with terminal guidance (MARV, see below; 16,17,38,93,103). Such accuracy is also known as "absolute", as it implies a direct hit of the target. The MARVed MX missile (16,37,38,93) is to be operative in the 1980s. The most precise Soviet ICBMs are ascribed CEP values of 500 m (17).

The improvement of the computers is largely due to their miniaturization and microminiaturization. A density of 1 million devices is reached per 1 cm^2 of a substrate material 0,25 mm thick, and a memory of 100 million bits per cm^3 (16). The accuracy in delivery is much improved by many kinds of most complicated and expensive devices that are based on inertial (gyroscopic) systems and on radiations of various kinds (16). The needed constructive precision may be gauged from the fact that a dust particle on a accelerometer, weighing 1 twenty millionth gram, already gives an error of 200 m in range and of 70 m in track, and that a shift in the centre of gravity of a gyroscope wheel from its symmetry axis by 1 twenty millionth cm gives an error of 100 m in range and of 70 m in track. All components must function in spite of the enormous strain during the launch and during the passage through the atmosphere. They are supposed to work in a range of accelerations 1 : 1 million, and always with a precision 1 : 100.000 (16).

To be ready for retaliation strikes, the strategic weapons in silos and submarines must, as has been mentioned, be programmed. This involves a most secret central document, SIOP - Single Integrated Operations Plan (105). The question arises which countries are included into this plan as possible enemies. (This question naturally also applies to the minor nuclear powers, e.g. France (105). Should the weapons be directed "tous azimouths", as ordered by de Gaulle?) To improve flexibility the replacement time of one target by a different target for an IBM has been cut down from 20 hours to 36 minutes, and the replacement can be carried out from the control tower (51,100,106).

From the MAD point of view, concern exists that a second strike of moderate strength, still possible after a particularly successful first strike, could be blunted by an improved ABM system (107). Consequently any hint about construction of ABM systems is bound to produce consternation on the other side. This is paradoxical, but justified. But in spite of further extensive and costly development work (100), no technical breakthrough has been achieved (18). The ABM installation in North Dakota, mentioned before, has remained the only such thing in the USA. After it had cost 6 billion dollars, it was, because of inefficiency, mothballed in 1976 (97). Not even the chances of antiaircraft defence are too good (36).

A more specialized problem is the killing of satellites (100). The satellites do not directly carry nuclear weapons now, but they are invaluable in connection with verification (spying), with early warning, with navigation and with the targeting of missiles. These unarmed satellites may be approached by killer satellites that are attracted by the heat emitted. They carry explosives or simply crash into their victims. Killers are cheap and can therefore be applied in large numbers.

C. MRV, MIRV and MARV

Crucially important are the MIRV missiles (Multiple Independently Targeted Reentry Vehicles: 108,109,110,111,112). In the early MRV Multiple Reentry Vehicle) system a missile scatters warheads, without individual aim, around a target (18,113). Later, warheads have been programmed individually against targets. All the warheads can be placed together on an inertially guided space bus, as the homely expression goes. According to its computer programme, the bus moves from one target to the next. On the way, it may change direction and speed, and the warheads are released one by one (114). Thus the total number of warheads in silos or submarines is multiplied. A typical warhead may weigh 100 kg, and have a yield of 200 Kt (15 times Hiroshima), but larger yields are also possible (1,17,93). Assuming good precision, large areas can be devastated more or less

uniformly, and useless oversaturation near a centre is avoided *). Thus each Minuteman 3 carries 3, and each missile on an improved Polaris submarine ("Poseidon") 10-14 warheads (1,16,17,31). Each submarine with its 16 launching tubes has, then, up to 224 warheads.

Problems in MIRV are due to the tremendous atmospheric effects of the explosions - strong electric fields, storms, dust clouds. These effects tend to reduce precision in trying to hit one and the same target by several warheads within a short time (interference, fratricide). On the other hand, these effects can make difficult (delay) the launching of enemy missiles that escaped destruction (101).

In a further stage, the MIRV is to be replaced by MARV (Multiple Manoeuvrable Reentry Vehicles). Here the warheads independently search for their targets (16,18,27,93,99,115,116,117,118). (On a smaller scale, "smart bombs" with chemical explosive were guided by reflected laser rays in Vietnam (89).) Orientation may be by the stars. In this way, the Universe at distances up to thousands of light years is at the service of the destruction of humans. Alternatively, orientation is obtained by observing the country with radar or laser radiation. Differences in height and even artificial structures (buildings) are observed. The information brought in by the "sensors" is compared with that in a map carried along on board, and the rocket is steered all the time on the basis of this comparison (16). The CEP value of MARVed warheads is said to be as small as 30 m (37). The MX rocket is to have 7-14 smart warheads.

D. Strategic Submarines

The "Trident" submarines, still in construction, are twice as large as the Poseidon submarines, and cost 1,5 billion dollars each (17,51,116,119,120,121,122). Trident will be faster and less noisy than Poseidon, and the range of the rockets will be 7500 km. (A similar range is quoted for rockets from Soviet submarines (123).) Trident will have 24 launching tubes, and each missile will have

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*) E.Wigner, like Teller and von Neumann originally a Hungarian, in 1969 bemoaned that in the transition from single to MIRVed warheads, because of the need for additional devices, the total tonnage in a missile is reduced. He overlooked that this (modest) reduction is overcompensated by far by the improved possibility to cover large areas uniformly (110).

10 warheads. They will be 400 Kt each, be MARVed, and in this way be endowed with absolute accuracy (100).

Submarines in the open seas are almost undetectable from a large distance (123). However, instruments for their location would not contradict any law of nature. In fact, billions of dollars (!) are spent each year for the development of such instruments and processes (18,124,125). The main part is played by passive and active ultrasound (sonar) methods, i.e. either the sound emitted by the boat or that reflected by the boat is measured. The diffusion of sound is strongly influenced by existing conditions in water and air. Hence the sensor output is combined automatically with meteorological and oceanographic data, as valid at the instant, by particularly efficient computers. The location of submarines at distances of 10.000 km is intended, but the technical difficulties are extraordinary (93,124, 125).

"Hunter-killer submarines" to fight the weapons carriers have been developed. They compete with their victims in diving capacity, speed and lack of strong noise (127). Already under-water speeds of 55 km/hour have been reported, and speeds of 70 km/hour are planned. The killers may shadow their victims in peace time already. Still the killers are suitable only for hunting single submarines, but they cannot as yet destroy all enemy boats at one blow. This would by needed to prevent retaliation strikes.

The submarines may be concealed in deep canyons at the bottom of the sea. There at the given time orders must reach them to come up and launch their weapons. The needed contact may be maintained by means of very slow electromagnetic oscillations that are propagated by the crust of the Earth ("Sanguine" and "Seafarer" communications systems). Signal-emitting, chessboard-like, antenna systems, thousands of kilometres long, would be buried underground (128, 129,130). So far no suitable area has been found in the USA, however (131).

E. Bombers and Cruise Missiles

The carrying capacity of the new ultrasonic, intercontinental, bomber B-1 (132) could be 250 % that of the existing bombers (28). It is also meant to carry most sophisticated equipment (18).

Therefore it would cost 56 rather than 8 million dollars apiece (121,133) - or even 70, 84 or 87 million (28,132,134). B-1 is supposed to reach speeds of 2000 km/hour, yet to be able to fly so low that radar location is difficult. Medium-range (500 miles) rockets could be launched from these bombers (28,99). About 250 such bombers were to be built (18,28,93), and they were to carry 5280 nuclear warheads (133). However, according to a directive by the US-President of June 1977, only prototypes are to be produced for the time being. The B-1 have been made superfluous by the arrival of the far cheaper Long Range Cruise Missiles (LRCM), as has been explained by Defense Secretary Brown (134). On the Soviet side, the "Backfire" bomber is being introduced which could undertake inter-continental missions provided it were refuelled in the air.

Much like the German V-1 in the last War, the cruise missile, e.g. the "Tomahawk", is driven by a jet motor and uses kerosene as a fuel, i.e. it is no rocket (16,102,115,132,135,136,137,138,156). The cruise missile flies very fast, typically at 800 km/h, and low enough (in suitable area: 15 - 150 m above ground) to be almost immune against radar, as existing. On the screen, it is no more conspicuous than a seagull or even a sparrow (156). The range may be 3500 km. The missile weighs less than 1 ton and the payload may be 450 kg. The cruise missile may perhaps be had for 0,5 - 1 million dollars each; hence it is also suitable for smaller powers (136). It can be launched in large numbers by many kinds of carriers, on land (trucks!), on sea, and in the air. For instance, a B-52 bomber can carry 25, a jumbo jet 100 such missiles (52,136,156). Like MARVed rocket warheads the cruise missiles find their way by use of a map, and are therefore extremely accurate (CEP 30 m). They can carry either chemical or nuclear (150 Kt) explosive. Because of this alternative, it is particularly easy with them to cross the barrier between conventional and nuclear warfare, the firebreak.

11. A New Strategic Doctrine

Technical progress has increased the temptation to prevent retaliation by means of a first strike of extraordinary force. The thought can be entertained to use the first strike not only for widespread devastation, but rather for the elimination of the enemy silos that had before been considered as indestructible.

Already with 2 warheads of 200 Kt each in a MIRVed Minuteman missile, assuming CEP of one quarter of a mile, a silo can be destroyed with 98 % probability (139). The possible "hardening" of silos cannot keep pace with destructive power (140,141). The seriousness of the situation is illustrated by a statement by J.D.Ryan (74), chief of staff of the US air force: "The multiple independently targetable reentry vehicle will be our best means of destroying time-urgent targets like the long-range weapons of the enemy".

The concern about first strikes has increased when Schlesinger on December 15th, 1973, explained a new, flexible, targeting doctrine. However, this only expresses developments that had already been under way for a long time (27,29,99,105,106,142). Briefly, the doctrine points to successful nuclear warfare rather than to prevention of nuclear war. Precise warheads and flexible guidance are not needed for deterrence, but invaluable for the destruction of silos, submarines and similar targets. Emphasis on them shows the tendency towards a successful first strike (16,51,52,100). With rockets, the first strike would be extremely rapid. While neither the USA nor the USSR have reached the capacity for a first strike that is fully successful with 97 % probability, such a capacity is said to be in sight at least for the USA (16,104). In particular, the MARVed MX is a step away from deterrence in the direction of nuclear warfare (143). The MARVed missiles from Trident, likewise with absolute accuracy, could also be used for first strikes.

According to Schlesinger there should be a wider choice of targets, not only among population centres, but also among military installations. This strategy is called "counterforce" rather than "countervalue" strategy. Such changes are made easier by the fact that the number of useful countervalue targets (towns, etc.) is far smaller than the number of strategic weapons (121). But a counterforce

strategy against silos is meaningful only in view of a first strike, or else only empty targets would be hit. Nor is it credible that an attacker would limit himself to the destruction of part only of the silos, as the enemy would be sure to retaliate from the remaining silos. Scoville (67) has emphasized the danger in assuming that the victim of a first strike against silos would not retaliate.

Possibilities of defence (ABM) hardy exist. But can the first strike be blunted? Very little time is available. As long as airplanes were the fastest carriers, the time interval between the recognition of the attacker by advanced radar lines and their arrival in the target area was at least 90 minutes. With the ICBM, the interval between launch and arrival is only 20 minutes, and the interval between the crossing of the radar lines and arrival only 15 minutes. With submarines, the time may be even shorter.

Hence a success of a first strike can be prevented only by launching one's own missiles before they are destroyed. The attacker then hits only empty silos. Of course, the missiles of the defendant must be directed against retaliation (countervalue) targets as the silos of the attacker are empty already.

So far the submarines, as yet partly safe, are stabilizing. Projects exist to put the ICBM, too, on mobile and invisible carriers, and in this way to make hits difficult (16,30,31,100). One possibility, e.g., are tunnels 30 km long in which rockets (MX) are moved according to a secret programme. This would cost at least 30 billion dollars (38,103,157). Alternatively, 4000 - 5000 vertical concrete tubes (silos) could be erected, between which 200 missiles would be shifted all the time by a fleet of 25 vehicles in a way ("shell game") that distinction between true and simulated transfers would not be possible from a distance (100,157). In the Soviet Union, the strategic SS-X-16 missiles are reported to have a mobile version (17). Clearly all these "multiple aim programmes" (MAP) would interfere with the verification of the number of missiles by national means in accordance with international agreements (17, 145,157).

12. The Ultimate Absurdity

Imagine the situation when a full nuclear attack is suspected! The decision maker (President, etc.) must be permanently ready to take the decision to end our world literally within a couple of minutes. Whether he is on a journey, attends a sports event, enjoys the birthday party of his grandchild, or even when he is deep asleep - at any instant he can be faced with the need to decide. No time for consultation, for questions, whether perhaps it is a case of error, of mystification or of an action by a madman, whether an instrument failed or confused missiles with flying geese or with the Moon, as has happened ..... No possibility to review the decision of the President, or to reverse it.

In his meritorious and frightening book "Race to Oblivion" (4) H.York sees a last consequence - a consequence that he destests (100,146): Launch on Warning. He sees an ever-stronger tendency to make decisions automatic. After reception of the automatized warning that enemy missiles are on the way, one's own missiles are launched semiautomatically or automatically, possibly without any inclusion at all of a human into the decision process. This means: as soon as the machines have detected aboved the horizon something which they consider as missiles and which moves on certain trajectories, the machines press, so-to-say, the button. Irrevocably hundreds or thousands of ICBM go into action. The enemy would hit empty silos, but follow up with blows against population centres. Mutual annihilation is guaranteed.

It is paradoxical: extreme automatization leads to excess strain in man. Temporarily one tries to escape by further automatization. The other side follows, and so the strain gets worse again. In this way, less and less security is obtained for more and more money.

Rightly this situation is called ultimate absurdity by York. Thinking observers that want to escape the spiral of escalation ask that the problems are met on another than the technical level. All too often it is forgotten that in the last analysis the problems are human problems, i.e. political problems. Hence true solutions can be sought and found only on a political level.

13. Outlook

The possibility of the SALT agreements is bound up with the incredible progress in the technology of verification (96,147). By means of photography or other techniques, objects on the ground that are a few centimetres (!) large can still be observed from satellites. (On the other hand, as mentioned, introduction of mobile carriers on land would make verification more difficult.) These methods will have to be developed even further if and when their task will not be detection of military activities, but verification of disarmament measures.

Alarm about the increasing dangers has surely been one of the motives for SALT. SALT 1 has lead to partial agreement in 1972. Unfortunately, no disarmament measures were included. On the contrary, the permitted levels often exceeded existing levels (148, 149). Agreement about SALT 2 has now (January, 1979) not yet been reached. Moreover, third powers, notably China, have not associated themselves with the negotiations.

Furthermore, we observe a strong tendency to compensate and overcompensate quantitative restrictions through qualitative improvements (18,149,150,151). Influential military, industrial and political leaders make their acceptance of agreements dependent on a widened possibility to follow up open lines of military development. Public finance rather than the paragraphs of SALT is limiting (36). On the other hand, the improvements in the weapons systems, however important they may be, are often not a result of a dramatic decision on a high level that must be separately financed and can be scrutinized in parliaments, for instance (100). Rather, every day large numbers of scientists and technologists are, as a matter of course, busy improving components. They keep within the routine budgets. When they are successful they also make progress in their carreer. The aggregate effect of this "technology creep" is tremendous. For instance, the reduction of CEP has been due such day-to-day work.

Since 1945 the abolition of the nuclear arsenals has, more or less sincerely, been generally accepted as a goal. This task has been made much more difficult by the discovery that all and any plutonium from power stations, i.e. also plutonium containing a

great deal of plutonium 240, can be used for nuclear weapons. By the year 2000 the world's power stations will produce material for hundreds of thousands of plutonium bombs annually (155). The scientific and technical know-how is no secret any more. The existing nuclear powers and the non-members of the Non-Proliferation Treaty (NPT) can in any case do with their plutonium as they please. Nor does NPT forbid any member the construction of the needed equipment for weapons. Therefore in a critical situation it will be sufficient to "fill in" the plutonium. Moreover, the members of the treaty can withdraw from it with only 3 months notice.

According to York an evil fact consists in the tendency of the falcons to worst-case analysis (73,99,147): all dangers are assumed to exist at the same time, even though every one of them, taken singly, has only a small, maybe a vanishing, probability. Planning is carried out on this basis. The opponent is forced to follow, and so endless escalation takes place. This way of looking at things often leads to counteractions in absence of actions.

It is tempting to introduce new weapons systems that force the opponent into even greater expenditure. An example is the cruise missile. Here the newly required defence system, however inadequate, will cost ten times more than the attack system (156). This approach is especially fruitful for the richer country, where, at equal monetary value, the outlay in relation to the national product is in any case less than for the poorer country. So the finances of the latter are ruined. This is, in the view of this author, a main reason why the USA maintain an enormously larger level of armaments than could, from the US point of view, conceivably needed in any circumstances. The oversize of the US armaments has been emphasized, e.g. by the outstanding physicist, P.Morrison (73).

Qualitative advances and new developments in armament technology could be hampered by total interdiction of all nuclear tests, including underground tests (152,157). Already now tests can almost always be detected seismically by national means, i.e. they are distinguished from natural events (153). Unfortunately, anderground tests up to 150 Kt are still allowed by the USA and the USSR (152). Apart from the tests admittedly carried out for military purposes, an ideal excuse for testing is provided by socalled peaceful nuclear explosions (PNE). The true economic value of such

explosions, for long times dear to Teller, is really small or zero (152,153).

Resistance is offered to the idea of a total test ban by the falcons not only on general grounds, but also for the specific reason that it would prevent periodic checks on the existing weapons (154). The military could not be sure whether the nuclear stockpile (really: the associated equipment) does not deteriorate during storage. So the demand is raised to keep permanently the possibility for a number of periodic tests at least.

H.York (158) has, on the basis of incomparable experience, explained that "the various promotors of the arms reace are stimulated sometimes by patriotic zeal, sometimes by a desire to go along with the gang, sometimes by crass opportunism, and sometimes by simple fear of the unknown. They are inspired by ingenious and clever ideas, challenged by bold statements of real and imaginary military requirements, stimulated to match or exceed technological progress by the other side or even by a rival military service here at home, and victimized by rumours and phoney intelligence. Some have been lured by the siren call of rapid advancement, personal recognition and unlimited opportunity, and some have been bought by promises of capital gains." But the real power behind the armaments drive is, of course, the military-industrial complex.

Any argument against disarmament and in favour of new weapons systems is taken up and developed by this complex. The more destructive and expensive these systems, the more prestige and power goes to the military leadership, overwhelmingly consisting of falcons, and the more business and profit goes to the manufacturers of armaments. The expression "military-industrial complex" has been coined by President Eisenhower. His farewell words were (159): "This conjunction of an immense military establishment and a large arms industry is new in American experience ..... We must guard against the acquisition of unwarranted influence ..... by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist." Eisenhower told York, who had become his personal friend, that these words were the decisive passage in his farewell address (160).

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