American Academy of Arts and Sciences

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10 November 1967

To: American Past Participants in Pugwash Conferences on Science and World Affairs

From: B. T. Feld, Chairman, Committee on P-COSWA of the American Academy of Arts and Sciences

Re: Annual Report

During the past year, the work of our Committee has been carried on as a cooperative effort of the American Academy of Arts and Sciences and the National Academy of Science, through the office of its Foreign Secretary. The present members of the Academy's Committee on P-COSWA are:

B. T. Feld, Chairman
E. Rabinowitch, Vice Chairman
Ruth Adams
H. Brown
P. M. Doty
J. T. Edsall
H. B. Glass
F. A. Long
M. Meselson
V. Rabinowitch
R. Revelle
A. Rich
C. H. Townes
A. M. Weinberg

The activities for 1966-67 included preparation for and participation in two Pugwash Conferences, the 16th, held in Sopot, Poland, in September 1966, and the 17th, held in Ronneby, Sweden, in September, 1967, which marked the 10th anniversary of the Pugwash Conferences. Reports of the Sopot Conference, which was devoted to problems of disarmament and world security, especially in Europe, have been published in the Pugwash Newsletters.

Also during the last year, the growing interest of American Pugwash participants in activities relating to the applications of Science and Technology to the problems of developing nations has led to the appointment by the American Academy of a Subcommittee on Development, with the following members:

E. Rabinowitch, Chairman
Ruth Adams
H. Brown
W. S. Dillon
H. B. Glass
E. S. Munger
V. Rabinowitch
R. Revelle
T. W. Schultz
E. B. Skolnikoff
C. L. Wilson

The Ronneby Conference was attended by about 200 participants from over 40 countries. The program had three aspects: (1) Three Symposia, one on Arms Control, Peacekeeping and Security, keynote papers given by M. D. Millionshchikov, F. A. Long, and M. G. K. Menon; another on New Approaches in Disarmament, papers by J. D. Cockcroft, L. A. Artsimovich and Alva Myrdal; and the third on International Cooperation and Development, papers by H. S. Brown, I. Malek, and R. V. Garcia. These symposia were held in plenary sessions and followed by lively discussion.

(2) Six Working Groups on: Arms Control; Peacekeeping and Security; New Approaches in Disarmament; International Programs in Science; Development, Education and Technology; and the Special Responsibilities of Scientists. Summaries of the work of these groups have been given public circulation in the Statement issued after the Conference by the Continuing Committee. This statement is scheduled to appear in the November issue of the Bulletin of the Atomic Scientists, and the complete reports of the Working Groups will eventually appear in the Proceedings of the 17th Conference (copies of the Statement by the Continuing Committee and a list of Conference participants can be obtained on request to B. T. Feld).

(3) General Discussions of the past value and future prospects of the Pugwash Conferences: A Committee on Future Activities, which met during the Conference, recommended a significant change of emphasis in future meetings towards a larger number of smaller conferences covering more specific and limited topics, with greater prior preparation and with the general aim of producing new and publishable results. This proposal was enthusiastically accepted by the Conference. Such a program will require greater assumption of responsibility for the preparation (both intellectual and physical) of these conferences by national groups, some of which would undertake to organize continuing studies, discussions and occasional conferences on some specific subject. (For example, the Czech group, which has taken a leading part in the Study Groups on Biological Warfare and on European Security, has offered to arrange and host one small meeting per year to be devoted mainly to the latter subject; the work of the BW Study Group has now been assumed by the Swedish International Peace Research Institute - SIPRI.) Along with this future emphasis on more specific and more "professional" studies and conferences, it was contemplated that the coordinating and guiding function of the Central Office would also need to grow, as would the funds required to insure the adequate participation of scientists from the smaller and the poorer countries. This growth will require an appreciable increase in the central office budget which, it was contemplated, should rise from its present $10-15K/yr by a factor of about four in the next few years. The US contribution to the central office, which has been around $5K/yr, would also need to be increased by a corresponding factor.

The death of Sir John Cockcroft, immediately after his assumption of the office of President of the Pugwash Conferences, has been a great blow. He will be difficult to replace, and his aid in achieving the goals of an expanded Pugwash program will be sorely missed.

As far as the financial situation of the US group is concerned, we would be faced with a serious problem even without contemplating the need for greatly increased support of a Central Office. In the past few years, we have been operating on a budget of around $15K/yr, mainly supplied by two three-year foundation grants, which have now terminated, and some very generous aid from the American Academy's Committee on Research Funds -- obtained for the purpose of activating studies on problems of development. We are now faced with the problem of renewing our sources of continuing support, and of finding new sources, either in the foundations or from individuals, not only for the support of participation in future conferences but also for undertaking studies and small conferences on specific arms control and development problems in the spirit of the new Pugwash approach.

It is in the context of these new developments that the Committee is now mounting its annual appeal for contributions from Pugwash "alumni". As in the past, the first $25 of an individual's contribution will be set aside for support of the London office, unless otherwise designated. However, we emphasize that even small contributions are invaluable for making a start on new projects.

Such contributions are tax exempt. Checks should be made out to the American Academy of Arts and Sciences, and sent to:

B. T. Feld
Room 26-425
MIT
Cambridge, Mass. 02139

You may be interested to know that our appeal in 1965 raised $425 from past Pugwash participants, and, in 1966, $985 was received. We are most grateful for this support, but we are hopeful that it will increase this year by an even larger factor than last. The Committee would also welcome suggestions and leads for fund-raising from other sources you may know of, especially of sources of support for specific new projects.

The 18th Conference will probably be held in France in the late summer or early fall of 1968.

B. T. Feld

Trude -
I'm delighted Maurice has accepted. Hope to see you one of these days; I'm planning to attend the 25th West Stands Anniversary in Chicago - will you be there?

Regards -
Bernd

Med hälsningar
Hannes + Kerstin Alfvén.

H.A.
Sept. 1971

PUGWASH ON THE POPULATION PROBLEM

At the XXI:st Pugwash Conference on Science and World Affairs "Problems of World Security, Environment, and Development" held at Sinaia, Romania, 26-31 August 1971, the population problem was discussed in two of the working groups, one devoted to "International Aspects of Environment Problems", and the other to "Economic and Technological Co-operation amongst Nations, in particular for development". The subject was introduced at a joint discussion of the two groups, chaired by professor Carl Djerassi, known for his outstanding scientific contributions in the field of human fertility and for his synthesis of new contraceptive medicals. Both groups included statements on the population problem in their reports.

One of the working groups stated: "Although the rate of population growth differs widely among countries, the rapid increase in world population is an alarming threat to the future of mankind. In many LDCs the annual increase in population is virtually as large as the annual increase in production, so that the increase in standard of living is small, if any. In many technically developed countries, e.g. the United States, it is widely realized that depletion of natural resources and pollution will cause difficult problems if these countries delay too long in taking steps to limit the increase in their populations.

How to control population growth constitutes a difficult problem which should be studied carefully by Pugwash. There is at present no ideal contraceptive method. We strongly urge that biological and medical research to find better methods be intensified. At present such research takes place only in a few countries. As different

methods may be applicable in different countries, it is important that study groups be formed, and research in this field started in as many countries as possible.

However, even with the contraceptive methods now available, a significant decrease in the number of unwanted births can be achieved. Knowledge of modern scientific advances should be spread, and the means of using them made available, preferably without cost, to all those who need them. Careful education in their proper use is essential.

As the spread of contraceptive methods necessarily takes time, abortion should be legalized, as an ancillary procedure, to reduce the number of unwanted births. Abortion is also necessary because of the imperfections of the present contraceptive methods.

In approaching all problems in this field, humanitarian considerations should predominate".

The other working group found that: "We were aware that the deterioration of the biosphere is by no means exclusively a consequence of the increasing size of the population. But it is evident that environmental problems will become more threatening should the population of the highly developed, and therefore now more polluting countries increase growing". The working group concluded that it was "in favour of popularising and legalising birth control on a world-wide scale:

a) By intensive sex education;

b) By chemical, pharmacological, immunobiological, surgical and mechanical means".

On behalf of the whole conference the Continuing Committee made the following public statement: "Although the rate of population growth differs widely among countries the rapid increase in world population is an alarming

threat to the future of mankind. In many LDCs the annual increase in population is virtually as large as the annual increase in production. Also the increase in population in the HDC countries is serious. In many technologically developed countries the depletion of natural resources and pollution will cause eventually serious consequences if the countries delay too long to take steps to limit the increase in population.

Biological and medical research on newer contraceptive methods should therefore be intensified in DCs as well as in LDCs. Since apes are the only suitable animal models for such work, the establishment of an international centre for primate breeding and primate reproductive biology in the Congo should be explored.

Already with the contraceptive methods now available, a significant decrease in unwanted births can be achieved. Knowledge of these methods should be spread and their use made available without cost. However, as these measures necessarily take time, abortion should be legalized as an ancillary procedure".

The two working groups and the Continuing Committee included participants from the developing countries, from Western and Eastern Europe (among other from the USSR), and from the USA. At the discussions it was stressed that the importance of the population problem differs widely among the countries and diverging views were expressed about its socio-economic causes and implications. However, the recommendations, as stated above, were not objected to by anyone.

The Continuing Committee decided that at the 22nd Pugwash Conference planned to take place in Oxford 1972, a working group should be formed especially devoted to the discussion of the population problem.

In order to give the background of the discussion at Sinaia the following papers are annexed:

H. Alfvén: "The Pugwash Movement". Lecture at the yearly meeting of Nobel Laureates at Lindau, 1971.

H. Alfvén: Excerpts from a speech at the opening session of the Sinaia meeting (Presidential address).

H. Alfvén: "The Population Problem". Working paper presented at the Sinaia conference.

Statement by the Pugwash Continuing Committee.

Stockholm, September 1971

Hannes Alfvén

The Pugwash movement

Lecture at Lindau, June 30, 1971, by Hannes Alfvén.

§ 1. Aims of the Pugwash movement

The Pugwash movement is an international organization of scientists concerned with the political and social implications of science and technology. It has originated out of the desire of many scientists that the result of their work should not be used for warfare, but for the welfare of mankind, and it tries to influence those who are responsible for the political decisions in the world in this direction.

Thus the aims of the Pugwash movement are

to clarify to all scientists that we necessarily have a moral responsibility for the use of the results we produce

to clarify to ourselves and to others what are the political and social consequences of our work

to try to find what measures should be taken in order to make the benefit a maximum and the danger a minimum

to try to convey the results of our discussions to the statesmen and other people who are responsible for the world affairs, and to inspire them to take actions along the lines which according to our discussions are appropriate.

§ 2. The Russel-Einstein Manifesto

The Pugwash movement was initiated by the so called Russel-Einstein Manifesto of 1955. The political situation at that time was that the atom bomb had been in

existence for almost a decade and the hydrogen bomb had also been tested. Both the USA and the USSR had started the nuclear armament race. Many scientists, whose scientific work had led to the construction of the bombs, felt more and more terrified when they saw what dangerous forces they had released. They were still more terrified by the fact that the politicians and the military people who conducted the nuclear armaments race seemednot to realize what dangers were involved in this activity. The scientists felt that the general public must be warned and pressure be put on the politicians, first of all not to use the bomb, and next to halt the armaments race.

This was the background of the Russel-Einstein Manifesto which was signed by a number of other prominent scientists. It described the dangers of the international situation, the completely new situation which mankind was facing in view of the enormous destructive capacity of the nuclear weapons, and it urged the governments - especially of the nuclear powers - to find peaceful solutions to their conflicts. Further it was suggested that scientists from all countries should meet to discuss the political situation.

An American industrialist, Cyrus Eaton, well-known for his attempt to foster good East-West relations, sponsored such a conference at a small place in Canada called Pugwash, from which the organization has its name. Following that conference nineteen more such conferences have been held in different parts of the world. For example the 19th conference was held in Sochi in the USSR, the 20th conference in Fontana near Chicago, USA. The 21st one is planned to take place in August this year in Sinaia, Romania.

§ 3. Topics of discussion

At these conferences we have discussed a number of political questions - especially the disarmament problem, arms control and security problems both in Europe and in other parts of the world. Besides these topics, which are so to say the classical Pugwash interest, other questions have now been added because of their importance to the progress of mankind, and the threat they imply to all of us if mishandled.

Among these problems should especially be noted the development of the poor countries. After the conferences in Udaipur in India 1964 and i Addis Ababa 1965, Pugwash has established good contacts in the developing countries, but aims at strengthening these relations as much as possible. The population problem and the distribution of the world resources are questions which claim an increasing interest from scientists all over the world. The Chicago conference devoted much interest to these problems. Also the pollution problem is being taken up at conferences and symposia.

Hence from initially being dominated by problems of nuclear warfare which affect mainly the USA - USSR relations, Pugwash is now broadening both its field of interest and its geographical basis. Furthermore, whereas in the early Pugwash the atomic scientists dominated, an increasing number of biologists and social scientists are now taking an active part.

§ 4. Government contacts

A serious problem for an organization of scientists is to avoid that the discussion becomes purely "academic", and has no impact on the world policy. The way the Pugwash movement has tried to avoid this was to try to include among its members scientists who have close contacts with the governments in their country.

The Pugwash members from the USSR come mainly from the leading circles of the Akademia Nauk. Many of the advisers of the USA president have been Pugwash members. Furthermore, Pugwash keeps good contact with the United Nations, UNESCO, The International Atomic Energy Agency, The World Health Organization and other international organizations, who regularly send observers to the meetings. It is essential, however, that these influential people attend the conferences as individual scientists and not as official delegates. The views they express at the Pugwash discussions are their private views, and great care is taken that they will never be kept responsible for the views they express in a way that would make their official position as government advisers difficult.

It has turned out that in many cases such an arrangement leads to informal negotiations between different governments which in certain respects are preferable to other types of negotiations. To some extent the career of a political negotiator is at stake at every negotiation; he must demonstrate that he can achieve a maximum of benefit for his country or his party - if not he may lose his job. A scientist, whose reputation is not connected with his formal success at a political negotiation, can discuss in a much more relaxed way. The people round the table identify each other not as adversaries from whom they should extract a maximum of concessions, but as scientific colleagues and often collaborators although from countries with different ideologies.

It is important that many of those who take part in these discussions have a double competence: they are distinguished scientists who can judge the scientific and technical aspects, and at the same time they have enough experience of political discussions to recognize the political difficulties associated with suggested solutions. They undestand very well that it is not enough that a solution is logical and advantages both to the individual people and to mankind as a whole.

It must also appeal to the leading politicians.

After every conference a symmary of the discussions is published in an official document which is distributed to different governments and intergovernmental organizations and other people interested. A quarterly "Pugwash Newsletter" is also published. Some of the symposia have resulted in monographs. Moreover, an important result of the conferences is the education of semi-official representatives of the different governments, the knowledge they get about the views of other delegates and about possible ways of approach to different problems.

§ 5. Organization

The organization of the Pugwash movement is done with a minimum of bureaucracy - and a minimum of funds. In most of the participating countries there are national Pugwash groups with a membership ranging from a few people up to several hundred. These meet for informal discussions which often result in papers clarifying important scientific and political issues. Some of these papers are presented at the Pugwash conferences and symposia and/or published in different journals.

The Pugwash movement is governed by the so called Continuing Committee with 17 members, of which three are from the USA, three from the USSR, three from the developing countries, and the rest from Eastern and Western European countries. This Committee is elected for a period of five years by all the members who have taken part in the Pugwash meetings. It decides about the general meetings, which usually are held once a year, and the Pugwash symposia, now usually about four every year. The Pugwash movement has a secretariat in London, which is run by the Secretary General of the Pugwash movement, Professor J. Rotblat, who from the first conference enthusiastically has devoted most of his free time to build up and keep

together the whole movement.

As the financial means of the international Pugwash movement are very small, the conferences and symposia are sponsored by the different national groups who find means wherever they can for organizing their activity. The economy of the Pugwash movement has always been, and is still extremely precarious, in part due to the fact that we can only accept money which is without any strings.

§ 6. Results

What result has Pugwash achieved by its activity? This is of course a question which should be judged by people not belonging to the Pugwash movement. Moreover, I believe that in principle it is difficult to give an accurate answer because of the way we work. We do not pretend that we can solve any international conflict - this is obviously a job which belongs to the statesmen. What we aim at is to create an international educated atmosphere, in which the real issues can be clarified, and the criteria for a sensible solution can be stated.

With this as a background let us list some of the problems which have been discussed at the Pugwash meetings and to the solution of which Pugwash has made more or less essential contributions. As stated above, the first Pugwash problem was the nuclear menace. Some scientists, who were terrified by the threat of atomic warfare, took up these problems at the meetings and used the Pugwash channels to arouse the world opinion about the danger. The non-proliferation of nuclear weapons was taken up for discussion in Pugwash already in 1958, and the international non-proliferation agreement of 1968 follows in essential parts ideas, which have originated in Pugwash. Also the international agreement to ban

atomic bomb tests in the atmosphere, in space, and under water has been developed during a number of Pugwash meetings. Ideas for recording of seismic data for the check of the underground bomb tests have also been discussed at Pugwash. But let us not forget that in the main issue we have failed: the nuclear armament race goes on and becomes more and more threatening every day. The discussion about the intercontinental missiles and the ABM have taken a major place in the Pugwash discucsions for a long time, and essential elements of these discussions are now continued in the SALT negotiations.

Another initiative derives from biologists and chemists who early realized the danger of bacteriological and chemical warfare. Some of them possessed facts from which they concluded, that secret preparations for biological warfare were made, and that rapid action against this was necessary. The problem was given high priority in Pugwash.

One of the results of this initiative is that an international agreement banishing bacteriological armaments and warfare is worked out and it is hoped that this can be signed in the near future. It goes without saying that this is a result of efforts from many different international organizations and Pugwash can only claim a small part of the credit. However, the early alarm, which is essential in this as in many other cases, could come only from socially responsible scientists, because only these understand fully the implications of the scientific and technical development.

The mentioned examples may illustrate how essential it is that scientists understand what responsibility we have for the application of the results of science. Many new discoveries can be used both for making the world better to live in or for making it worse. Those

who make the discoveries do not always realize what social and political consequences they have, until they have discussed them with colleagues. One of the aims of Pugwash is to serve as a forum for such discussions and to try to find what measures should be taken in order to avoid the destructive power of science and make use of it to the welfare and progress of mankind. As at present the technological development seems to produce so many new threats to mankind, there is an enormous quantity of qualified work in store for us.

Encl. Pugwash Conferences
Pugwash Symposia

References.

J. Rotblat: Pugwash - the First Ten Years.

Pugwash Literature can be obtained from

Prof. J. Rotblat
Pugwash Conferences on Science and World Affairs
9 Great Russell Mansions
60 Great Russel Street
LONDON, W.C.1.

Telephones: 01-405 6661
01-253 9875
01-435 1471

PUGWASH CONFERENCES

Serial Number	Date	Location	Number of Participants	Number of Countries
1st	July, 1957	Pugwash	22	10
2nd	March-April, 1958	Lac Beauport	22	8
3rd	September, 1958	Kitzbuhel	70	20
4th	June-July, 1959	Baden	25	7
5th	August, 1959	Pugwash	26	8
6th	Nov-Dec, 1960	Moscow	75	15
7th	September, 1961	Stowe	41	12
8th	September, 1961	Stowe	43	11
9th	August, 1962	Cambridge	67	19
10th	September, 1962	London	175	36
11th	September, 1963	Dubrovnik	64	24
12th	Jan-Feb, 1964	Udaipur	56	25
13th	September, 1964	Karlovy Vary	74	19
14th	April, 1965	Venice	68	20
15th	Dec 1965-Jan, 1966	Addis Ababa	63	31
16th	September, 1966	Sopot	69	22
17th	September, 1967	Ronneby	180	44
18th	September, 1968	Nice	81	29
19th	October, 1969	Sochi	101	29
20th	September, 1970	Fontana	98	31

PUGWASH SYMPOSIA

Symposium	Dates	Place	Topic	No.of participants	No.of countries
1	6-11 Apr. 1968	London, UK	Control of Peaceful Uses of Atomic Energy with particular reference to non-proliferation	40	16
2	13-18 May 1968 8-10 Sept. 1968	Mar.Lazne Czech. Nice France	Scientific and Techn. Cooperation in Europe as a contribution to European Security	36	17
3	14-20 July 1968	Krogerup Denmark	Implications of the Deployment of Anti-Ballistic Missile Systems	27	12
4	12-17 Apr. 1969	London, UK	Economic Aspects of Energy Production(with particular ref. to nuclear power)	32	14
5	19-24 May 1969	Mar.Lazne Czech.	Role of Science and Scientists in National and world Affairs	27	11
6	7-12 Sept. 1969	Elsinore Denmark	An International Agency for the Collection and Dissemination of Information on Potential Crises	22	9
7	9-12 Dec. 1969	Radziejowice Poland	Arms Control and Disarmament Measures in Europe	19	9
8	19-23 May 1970	Oberursel F.G.R.	Overcoming Protein Malnutrition in Developing Countries	29	11
9	5-8 June 1970	Noordwijk Netherlands	The Setting Up of Institutions for European Scientific and Technical Cooperation	35	13
10	26-30 June 1970	Racine U.S.A.	Impact of New Technologies on the Arms Race	39	10
11	1-4 Sept 1970	Stanford U.S.A.	What can Scientists do for Development?	48	16
12	18-21 Febr. 1971	Geneva Switzerland	Rapid Detection and Identification of Microbiological Agents	28	9
13	14-17 April 1971	Frascati Italy	Social Aspects of Technological Change	40	12
14	20-23 April 1971	Leipzig G.D.R.	Economic and Social Aspects of Disarmament	31	14

Excerpts from Presidential Address
21st Pugwash Conference on Science and World Affairs
"Problems of World Security, Environment, and Development"
Sinaia, Romania, 26-31 August 1971

4. Population

At the Fontana conference we discussed the population problem for the first time. I think this was a rather late start for one of the really serious threats to mankind. At the meeting some very interesting points were presented, but on the whole I think the discussion was too biased and too superficial. We have to dig much deeper into these problems. Especially we should avoid both the Scylla of the laissez-faire - these problems will solve themselves automatically - and the Charybdis of the defeatist - the situation is hopeless, there is nothing we can do. Neither of these statements is true, neither of them is reconcilable with the responsibility which we feel for the future of mankind.

Since the Fontana Conference there are some new factors affecting the population problem. There is a rapidly growing concern in the USA about the population increase in the USA. It is realized that in the long run the country cannot support an increasing population at the present, or an increasing, standard of living without too much pollution and too much depletion of the raw materials of the country of of the whole world. There is a movement called Zero Population Growth. Furthermore, according to a number of reports China is taking the population problem very seriously and making a strong drive towards a zero growth. Mao-Tse-Tung is quoted to have said that China should aim at a stable population. In China a contraceptive pill is manufactured which is reported to have less unpleasant side-effects than the Western pill. There seems to be no statistics available by which one can judge how successful the Chinese have been in stopping the increase of the largest population in the world.

On the positive side one should further note that more and more governments seem to understand how important and serious

the problem is. However, so far this is mainly lip service. The net result is that the catastrophic rate, at which the population of the world is increasing, has not diminished and nothing seriously is done to stop it. One seems not to realize that in a world with finite resources there is necessarily a contradiction between the old principle that every family can have as many children as they like, and the new principle that every child has the right to get food, care and education.

The Population Problem*

Working paper presented at the Pugwash Conference

21st Pugwash Conference on Science and World Affairs

"Problems of World Security, Environment, and Development"

Sinaia, Romania, 26-31 August 1971

by

Hannes Alfvén

I

The Population Problem and Pugwash

An early suggestion that Pugwash should give a high priority to the population problem met a number of objections. In the following some of these are listed, and it is argued that none of them is valid.

1. Population problem not very serious

Some years ago this was a generally accepted view. It was claimed that there are still large regions of the earth which are underpopulated, and that it was favourable to everybody if the total number of people in the world increased. Such views are obsolete today. Extrapolations of the present increase have shown that unless stopped very soon, the population explosion will produce an intolerable situation on our planet. This is clearly expressed in a number of competent papers, i.e. in the chapter on population in "Resources and Man" prepared by the U.S. National Academy of Sciences (Freeman & Co., 1969). Anyone who claims that the population increase is not serious should read this article, and if he disagrees state the reasons why. It is essential that this basic point of all discussions of this subject is absolutely clear.

If the number of individuals N of a certain species increase at a rate $a \cdot N$ per year where a is a constant, and

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* Edited version of XXI-12 combined with XXI-25.

the number is N_o at a certain time, it is $N = N_o \exp [aT]$ at a time T years later. If $b = N/N_o$, we have $a = (\ln b)/T$. As in the case of interest b is a rather small number (10 or less), the value of a is limited and can have a high value (like the present 0.023 for the world population) only for a limited time. For large values of T (comparable to the length of human history) the average value of a must necessarily be very close to zero. For example: if b = 10, T = 1000, a is 0.0007.

Hence it is only because the present century represents a historically exceptional period that many people have the impression that the present population increase is something normal. Historically speaking the only normal value of a is very close to zero. With mathematical certainty the world population will return to this normal average value within a historically short time.

Hence in reality we cannot discuss the problem whether the present population increase shall be stopped or not because the answer to this question is obvious: it will stop independently of what we do. However, there are some questions the answers to which depend on our actions:

1. Shall it stop through a catastrophy or by a sensible levelling off?
2. At what world population shall it stop?
3. Will it stop automatically or what means shall be used to stop it in order to avoid a catastrophy?

2. Population problem will solve itself with increasing standard of living

In Europe the rate of increase in population has decreased the last century and at the same time the standard of living has increased. Although no sociologist seems to have proved that it is just the increase in standard of living (and not e.g. the educational standard or other social factors) that has produced this effect, there are many people who believe this. They claim that if only the

standard of living of the non-industrialized countries could be increased rapidly, the population increase would stop automatically. There seems to be no foundation for this claim. Even in the USA, with a very high standard of living, the rate of population increase is too high (according to the views of an increasing number of people). Furthermore, if this view is true, the non-industrial countries are caught in a circulus vitiosus because in most cases the increase in production hardly exceeds the increase in population.

3. The "Green Revolution" will provide enough food for an increasing population

As the present population increase, if unchanged, necessarily carries the population towards infinity, any finite increase in food production does not change the necessity to stop the increase in population. The only thing the Green Revolution possibly can achieve in this respect is to postpone the date of a catastrophy. This is valuable only if the time which is gained is used in a sensible way. Dr. Borlaugh who is considered to be the main mover of the Green Revolution has warned emphatically that this does not relieve us from the necessity to check the population increase.

Warnings have been heard from several sources not to exaggerate the importance of the Green Revolution. Its impact on different social structures may be very complicated, and if not combined with a check of the population it may even be harmful. The postponement of a coming catastrophy may make this worse.

4. It is impossible to stop the population increase because it is due to ingrown habits and they can be changed only very slowly

This view, which seems to be common, is very difficult to understand. Both the Russian and the Chinese revolutions

have changed the views and habits of large populations drastically, and also in countries without revolutions many habits of our generation differ drastically from those of our parents. This is most conspicuous in the sexual habits, a field closely related to the reproduction.

It is true, however, that what has been done so far in the field of birth control has produced inconspicuous effects in most countries. However, this does not necessarily prove that the problem is impossible to solve. It may also be caused by inappropriate methods or a lack in a vigorous push of the birth control. The example of Japan shows that a resolute policy can change one of the highest birth rates in the world to one of the lowest in five or ten years. A recently started campaign in Bombay shows also very promising results.

5. There are a number of international and national organizations which already are active in this field. Hence there is no reason why Pugwash should take up the problem

This argument can be used against any Pugwash activity. The arms race, the international relations etc. are all "taken care of" by U.N. and a number of international commissions. The raison d'etre of Pugwash is the belief that in many fields we can help similar institutions and in some respects do a job which they cannot do.

However, in this as in many other fields, a Pugwash initiative necessarily must be taken with much care. It is obvious that the existing institutions have achieved very little results in decreasing the rate of population increase. This makes it important to try new initiatives, but we can expect that not all the existing institutions will receive a Pugwash initiative in a positive way. There is obviously a risk that some institutions which have not been successful, will claim that this is because the

problem is impossible to solve. They may react in a negative way to everything they regard as an attempt to prove that this conclusion is not valid. It is important that Pugwash adopts the view that even if the institutions have not been successful their work has been valuable because it has demonstrated the difficulties with the used methods. In this respect the lack of success in solving the population problem is analogous to the arms race problem.

It is essential that Pugwash on one side pushes and collaborates with existing sound projects but on the other hand feels free to criticize them and initiate new and hopefully better approaches.

6. The population explosion is a favourable factor because it contributes to the fall-down of obsolete social structures

It is claimed that in those countries where the social and political structure is such as to make real development impossible in the long run, anything which makes the present situation worse should be evaluated as good in the long run, because it will produce a break-down of the present structure. If we accept this view - which not everybody does - we cannot claim that the population increase necessarily is a favourable factor. In many cases its dominating effect is to create an increasing number of undernourished and undereducated people. These are usually too passive to be able to constitute a revolutionary active group. Revolutions - violent or peaceful - are usually made mainly by groups which have at least a minimum of education and enough food to be active.

7. As the population explosion does not lead to a politically unstable world situation it is not a Pugwash concern

If (6) is not true, (7) may be correct. However, Pugwash cannot limit itself to the concern of a stable

world situation. It must necessarily also aim at a state when everybody in the world has at least a minimum of food and happiness.

Finally, it should be remembered that in the discussions about population problems the following argument is of considerable importance. A group (national, racial, or religious) has nothing against birth control when applied to other groups, but objects when it is applied to its own members. The reason is a desire that the own group shall outgrow other groups or a fear that other groups will outgrow the own group. This chauvinistic attitude, which is related to the driving force of the arms race, has to be studied by Pugwash.

II

On the Present State of the Population Problem

A list is presented of some points which need to be clarified at the Pugwash discussions.

1. The population problem concerns both LDC:s and DC:s*

For quite a few years there has been an abundant flow of papers and books demonstrating the catastrophic consequences of a continued increase in the world population. Furthermore, during the last few years it seems to be generally recognized in the USA that not even the population of the USA can be allowed to increase at the present rate without very unpleasant consequences. To my knowledge there has not so far been any serious attempts to question these results. Indirectly they are supported by the very thorough study which Gunnar Myrdal has made of the future of the (non-communist) LDC:s. He takes for granted that very little could be done to stop the population explosion and arrives at very grim predictions. The only way to avoid his pessimistic prophecies seems to be

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*LDC:s = low developed countries, DC:s = developed countries

to make a very strong effort to stop the population increase.

An important point to be clarified at the Pugwash discussions is whether this general view of the danger of the population explosion is correct.

2. Population problems should be discussed in all countries

Provided the answer is yes, it is essential to spread information about it and to stimulate similar discussions in many countries, which so far have not taken part in it. It is especially important to inform the responsible governments and make them motivate their present attitudes in the light of this. Their basic attitude should not start from the current population programmes trying to evaluate what could be achieved through them. On the contrary, one should start from what must be done in order to avoid a catastrophe and see what measures must be taken.

3. Three aspects of the problem: Better methods for birth control

It seems that the limitation of the increase in population has three different aspects. The first is that one must find new and better methods for birth control. Dr. Djerassi discussed this problem in his lecture at the Fontana conference and in the paper he is presenting at Sinaia.

4. Application of existing methods

The second aspect is that, already with the present methods, drastic reductions in the birth rate are possible. Indeed, in many countries such methods are used already. One can also quote the fact that in the course of a few years Japan succeeded in reducing its birth rate from one of the highest to one of the lowest in the world. The

first method used in Japan was abortion, but later this was complemented by other methods. In some Eastern European countries similar methods have also been successful. There are reports that China has taken strong action to reduce its population increase by a combination of abstinence, postponement of marriage, abortion, the contraceptive pill, and other methods. In Bombay there seems to be a promising project showing that vasectomy is a method acceptable to the Hindus, the Moslims, and the Christians.

It should be clarified to what extent different family planning methods are available to the population - especially the poor part of it - in different countries, and find what could be done in order to give them necessary information and means for family planning.

Some of the population regulating methods are supposed to be "cruel" (especially abortion) or produce unpleasant side effects. These adverse effects should be compared to the misery of large populations, which to a considerable degree is a consequence of the absence of birth control.

5. Motivation

The third aspect is that birth control methods are of little use unless the people are strongly motivated to use them. This is perhaps the most difficult problem and, because of an erroneous approach, several of the existing aid programmes seem to have failed.

The help which DC:s can give to LDC:s is limited. For obvious reasons foreigners have great difficulty in introducing family planning in a country. The main initiative must come from active groups within the country itself, and the main work must be carried out by them, because a detailed knowledge of how society works is essential. A foreign aid group could be of some help, but only under the condition that its members have a

very good knowledge of the society, including that they speak the native language (or languages) fluently. This means that the aid groups necessarily should include - and possibly be directed by - social antropologists, etnographers and other people, who are familiar with the culture of the country to which they are going.

6. Could reproduction habits be changed?

An aid group which does not satisfy these conditions necessarily achieves very little. Often it may cause an adverse reaction. This gives, of course, rise to a feeling of frustration among the members of the aid group, and naturally they conclude that it is "impossible" to change the reproduction habits of the people. This is probably not true. In the field of sexual relations and reproduction rapid and drastic changes are often witnessed. As an example, the present "Victorian" morale in India contrasts in a striking way with some temple sculptures, indicating that a complete change in attitude has taken place. Well educated American girls today often carry a button "Make love - not children" which would have been impossible only ten years ago. Successful family planning in some countries also demonstrates that the usual defeatist attitude is not motivated.

There is a rather common belief that the population problem will be solved "by itself" if "only" the standard of living of the people is raised. The fact that it is now realized in the USA that the US population cannot be allowed to grow at the present rate, indicates that this view is misleading. Even if the standard of living in the LDC:s could be raised to the US level, this would not be sufficient for the population problem to be solved "by itself".

Furthermore, the high birth rate in the USA is reported to be due to the high number of children in the well-to-do families.

7. Resistance against population limitation

One cannot avoid the feeling that in many countries there is a tacit resistance against any attempt to limit the population increase, because of a feeling that a large population is an important asset to the country. A populous country is supposed to be more mighty and prestigious than a country with a small population. There is also a fear that neighbouring countries will "outgrow" one's own country. The following discussion is meant to raise the question whether this attitude may be based on obsolete ideas.

As a simple model let us characterize a country by its population N, its natural resources R, its industrial equipment M and the average standard of living L. The national income I is a function of the population, the resources, and the industrialization. A part of it LN is used to support the population at the standard of living L. The rest of it

$$P = I - LN \qquad (1)$$

is at the disposal of the rulers of the country. At different epochs and under different conditions it may be used for building royal palaces, cathedrals, citadels, buying armaments, increasing the industrial capacity, or - to the extent that the rulers are "philosophers on the throne" - to education, science, and other cultural activities. Thus P is a measure of the freedom of action the rulers have when the people have got a standard of living which the conditions require. It is suggested that P is a quantity which many rulers try to make as large as possible, feeling that it is a measure of their power or prestige. If they use it for armaments their military power increases, if they use it for industrialization the wealth of the country will increase. If P is negative they are at the mercy of aid-giving countries.

The national income depends on the population of the country. We may put

$$I = A + BN \qquad (2)$$

where A and B are constants in the range of interest. We consider two extreme cases, viz. when the first term in (2) is negligible and when the second term is negligible.

The first case means that the production is proportional to the number of people. This may be applicable in an underpopulated agricultural country, where more people can cultivate more soil, or when an increasing population can produce more handicraft. In this case we have

$$P = N(B - L) \qquad (3)$$

With a given value of B - L, P is proportional to N. A large population is advantageous.

The second case means that the production is independent of the population. This may be the case in an overpopulated country, where there is no more soil to cultivate. Industrialization is also acting in the direction towards this case. If the natural resources are exploited by machinery, and goods are mostly produced in more or less automatic factories requiring few workers, an increase in population may not increase production, but result in more unemployment. In this case we have

$$P = A - LN \qquad (4)$$

A ruling group which wants to increase P should be anxious that N should not increase. If in a country of this type the population increase had been checked, say, 25 years ago then - ceteris paribus - P would now be larger, the country would be more powerful, or L could be raised.

It should be investigated to what extent these very simple models could be applied to different countries.

It should also be studied, whether the ruling groups in some countries believe that formula (3) is valid, whereas in reality formula (4) is closer to truth. If this should be the case it is extremely important that this is clarified to the ruling group. If they fully realize that a large population is against their interest and the interest of the country, they may give the population problem the top priority which it ought to have.

21st Pugwash Conference on Science and World Affairs
Sinaia, Romania, 26-31 August 1971

STATEMENT BY THE PUGWASH CONTINUING COMMITTEE

The Twenty First Pugwash Conference on Science and World Affairs was held in Sinaia from the 26th to 31st August 1971, at the invitation of the Romanian Pugwash National Committee.

The Conference was attended by 97 scientists from 31 countries; in addition there were 9 observers from 5 international organizations.

The theme of the Conference was "Problems of World Security, Environment, and Development", and under this title participants discussed the following topics in five Working Groups: (1) European Security Problems, (2) Current Conflicts, (3) International Security and Further Steps towards Disarmament, (4) Environmental Pollution, (5) Economic and Technological Co-operation amongst Nations, in particular for Development.

The reports of the Working Groups were presented and discussed at plenary sessions of the Conference. The statement that follows has been prepared by the Continuing Committee on the basis of these reports.

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5. ECONOMIC AND TECHNOLOGICAL CO-OPERATION AMONGST NATIONS, IN PARTICULAR FOR DEVELOPMENT

There was general agreement on the crucial importance of economic and technical co-operation among developed countries (DCs) and less developed countries (LDCs) and on the necessity of avoiding that such co-operation be accompanied by domination or the exertion of pressure by the DCs.

Steps should be taken to increase the involvement by scientists from the LDCs in the Pugwash Movement, including the activation or formation of Pugwash groups in Latin America, Africa and South East Asia.

Among the Group's specific recommendations, the following merit special emphasis:

(a) Population Growth

Although the rate of population growth differs widely among countries, the rapid increase in world population poses a very serious problem to the future of mankind. In many LDCs the annual increase in population is now virtually as large as the annual increase in production, so that the increase in standard of living is small, if any.

In many technologically developed countries, the depletion of natural resources and pollution will eventually cause difficult problems if these countries delay too long in taking steps to limit the increase in their populations.

In discussing population growth, the Group did not discuss the broad socio-economic aspects of the problem. It restricted itself to a discussion of practical aspects of fertility control, which are, or will become, an essential aspect of the problem in all countries even if, as we desire and hope, accelerated increase in agricultural and industrial productivity could be achieved in all parts of the world.

Biological and medical research on newer contraceptive methods should therefore be intensified in DCs as well as in LDCs. Since higher apes are the only relevant experimental animals for such work, the establishment of an international centre for primate breeding and primate reproductive biology in the Congo should be explored.

Already with the contraceptive methods now available, a significant decrease in unwanted births can be achieved. Knowledge of these methods should be spread and their use made available without cost. However, as these measures necessarily take time, abortion should be legalized as an ancillary procedure.

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WORLD HEALTH ORGANIZATION - GENEVA

RESEARCH ON THE BIOMEDICAL ASPECTS OF FERTILITY REGULATION

TAKEN FROM A DRAFT PAPER PREPARED FOR
THE 1974 WORLD POPULATION CONFERENCE

by

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RESEARCH ON THE BIOMEDICAL ASPECTS OF FERTILITY REGULATION AND ON THE OPERATIONAL ASPECTS OF FAMILY PLANNING PROGRAMMES

Social concern with family planning and the regulation of fertility stems from the realization that birth planning is important to social welfare, including health; it acknowledges the right of individuals to a reproductive behaviour consistent with their goals, values and circumstances; and it addresses itself to resolving problems of population growth.

In the last 10 years this social concern has been translated into organized action at local, national and international levels, to make available family planning care. This has taken the form of education and information about reproduction and its regulation, the provision of methods of fertility regulation and the services required for their continued use, and in certain cases other related activities, such as the treatment of infertility.

The impact of these measures in different countries is difficult to assess with any degree of precision. However, certain general trends have emerged. In many of the more developed countries, the necessary services have become more widely accessible to the whole population. A broader range of contraceptive methods is now available, including in some countries legal abortion and sterilization. The number of unwanted pregnancies and illegitimate births, with their accompanying personal and social burdens appears to be decreasing. The wider provision of family planning services has not necessarily resulted in reduction in the already low birth rates of these countries, although it has tended to substitute more modern forms of contraception for the traditional methods.

It is even more difficult in the less developed countries to assess the results of family planning efforts. Some observers, at this early stage of development of programmes, view with satisfaction the establishment of administrative structures and operational mechanisms for family planning. To them, the beginnings made in services, even though their coverage may still be restricted, are grounds for optimism: a proportion of couples appear to have been reached by programmes, and indeed, a group of countries with anti-natalist policies have shown over the last decade a reduction in the birth rate.

Other analysts of the same data have questioned this interpretation. They emphasize that, in the best instances (Singapore, Taiwan and Korea) no more than 25% of women have adopted family planning through the government programme; in most developing countries the proportion is much smaller, ranging from less than 1% to about 13%. Moreover, in these countries, adoption of the modern contraceptives, after an initial rise in acceptance, has either reached a plateau, or is being counteracted by alarming levels of discontinuance. The reduction in the birth rate of certain countries is ascribed to other socio-economic changes (e.g. industrialization, improved education and economic opportunities) that may have affected reproductive patterns rather than to the family planning programmes. Lastly, the cost-effectiveness ratio for the programmes is low, and the expenditure on them is out of proportion to the national economy.

Clearly, the trends can be interpreted with varying degrees of optimism or pessimism, nevertheless the actual levels of family planning practice remain far removed from the goals set by the programmes. Analysis of the causes of this comparative failure is complicated by the interaction between social, economic, cultural, political and personal factors. However, the problems that have emerged in most programmes centre around the adequacy of the approaches used to deliver family planning care, the motivation of individuals to practise family planning and to utilize the services, and the availability of methods of birth control to meet a variety of personal needs and preferences, for continued and successful practice.

This paper will deal with one aspect of these problems, namely the potential role of biomedical research and development in their solution. The necessity for such research has not gone unchallenged: it has been stated, for example, that available contraceptive technology has proven its success; all that is required is to make it available on a wide enough scale. However, every new advance in this technology has introduced family planning to additional groups in the population while still failing to meet the requirements of others. Moreover, despite these advances, the technology remains relatively crude, inconvenient and, for many methods, associated with unacceptable side effects on health.

This paper is divided into the following sections:

1. Characteristics of methods of birth control

1.1 The biologist's and clinician's point of view

There is a variety of methods of birth control presently available. The biologist tends to classify them according to the step of reproduction with which they interfere; these steps include the formation of eggs (ova), the coming together of egg and sperm (fertilization), the imbedding of the fertilized egg in the womb (uterus), and the course of pregnancy. The primary concerns of the biologist and the clinician are to achieve a high degree of effectiveness in a method for regulating fertility, and to avoid any risk to health entailed by its use.

1.2 The user's point of view

The perspective of the individual man, woman or couple is somewhat different although to them also effectiveness and safety are important. Choice of contraceptive may be largely determined for them by the circumstances surrounding its use: whether by the man or the woman, whether immediately before or after the sex-act, or dissociated from it entirely, whether it involves drugs, devices, or surgical interference, whether its effect is temporary, permanent, or reversible. Social, cultural and moral considerations will all play a part in influencing use of specific methods. Cost may also be a determining factor, as well as ease of obtaining and source of the contraceptive. A method such as the IUD which involves a gynaecological examination may be unacceptable to certain cultures.

1.3 The policy maker's considerations

The factors influencing personal preferences in the acceptance and continued use of methods of birth control should be the primary determinants of the policy maker's choice of methods for family planning programmes. He may, however, be limited by other constraints, such as lack of availability of: trained staff required for management of certain methods (e.g. for IUDs or vasectomy); special facilities (e.g. for abortion); adequate channels of distribution (e.g. for condoms and pills); shortage of funds (e.g. for purchase of foreign goods such as pills). The selection of methods, however valuable they might be, is likely to be subject to pressure from special groups, professional, commercial, religious or political. It will also be influenced by the characteristics of certain population groups, such as level of education, motivation for family planning, health and nutrition status.

1.4 Need for a wide range of contraceptive methods

One of the immediate implications of the multiple requirements outlined above is the need for a wide range of contraceptive methods. The quest for an "ideal contraceptive" is based on the mistaken and simplistic assumption that any single method would be universally acceptable. The differing extent to which presently available methods are being used gives an indication of the spectrum of individual preferences and cultural requirements on the one hand, and the need for continued research and development on the other.

2. Present methods of fertility regulation

The most widely used methods include the "traditional" methods, either behavioural (rhythm and coitus interruptus) or locally applied (condoms, diaphragms and spermicides), and more modern methods, intra-uterine devices, the pill, male and female sterilization, and abortion.

2.1 Traditional behavioural and locally applied methods

The rhythm method is based on abstinence from intercourse during the period when a woman might conceive. The length of the period will depend on the method used to detect

ovulation and the degree of "safety" desired. Correctly taught and practised, it may be effective, but success requires motivation and self-control by both partners, and the ability to record menstrual events and temperature. The relatively irregular cycles of many women and the continued inadequacy of simple methods for detecting ovulation in the home reduce the usefulness of the method. Although the extent of its use is not documented, it is widely employed among some groups.

Coitus interruptus is probably the oldest contraceptive procedure known to man, and continues to be widely practised in many countries of Europe and the Near East. Its effectiveness in preventing pregnancy has never been accurately assessed, nor have the great variety of physical and psychological side effects that have been ascribed to it.

The traditional locally applied methods, used by men (e.g. condoms) or women (e.g. diaphragms and spermicidal jellies and foams), prevent fertilization by providing mechanical or chemical barriers to the passage of sperm. Figures derived from several countries on protection from pregnancy vary considerably: although when good quality goods are used correctly a relatively high protection rate (of the order of 2 to 4 pregnancies per 100 women per year) can be achieved, the fact that repeated motivation is required for consistent success leads to much higher failure rates, ranging from 10 to 20 pregnancies per 100 women per year. The condom continues to be widely used, and is increasingly incorporated in national family planning programmes in developing countries. Estimates of the number of users (about 25 million in developed and developing countries) are approximate since they are based on total sales and distribution figures of condoms rather than on accurate figures of actual use by individuals. On the other hand, use of the diaphragm, which has anyhow been largely restricted to the developed countries, has decreased since the introduction of oral contraceptives.

Some generalizations can be made about all traditional methods, in spite of their considerable heterogeneity. With the exception of the diaphragm, they do not require medical examination. Their efficacity can be greatly increased by some instruction in their use, particularly in the case of the behavioural methods. Condoms and spermicides

only need commercial distribution channels. The behavioural methods involve essentially no supplies. All the traditional methods can be said, in the long run, to be relatively unreliable, particularly as they require a high degree of motivation. Apart from some possible effects on psychological well-being, their use is free of side effects on health.

2.2 Intra-uterine devices

Intra-uterine devices (IUDs), manufactured in various materials and shapes, are inserted in the uterine cavity to prevent pregnancy. The exact way in which prevention of pregnancy is achieved is still not clear, but the effect seems to be restricted to an action on the uterus. There is no evidence that their anti-fertility action involves interference with the implanted embryo.

IUDs may be no more effective than some of the traditional methods of contraception when the latter are correctly used. However, IUDs have proved far more effective (2 to 3 pregnancies per 100 women per year) than all traditional methods if continuous motivation is lacking since they require essentially no action after the initial insertion. Moreover, the fact that their use is dissociated from the sexual act appeals to a great many people.

There are a number of drawbacks to the use of IUDs. Many women find the thought of a foreign body inside them objectionable. Insertion requires a pelvic examination which may not be acceptable to some women. Trained personnel are needed for the procedure of insertion, which entails a slight risk of perforation, and frequent discomfort. The highest frequency of side effects occurs during the first three months in the form of some pain and bleeding. Changes in menstruation which are personally or culturally unacceptable cause many women to have the device removed soon after insertion. In a small but significant percentage of women who have used IUDs for a year or more, a disturbing increase in menstrual bleeding has been noted. Unnoticed expulsion of the IUD represents another hazard, since the woman is unknowingly exposed to pregnancy.

At present, probably about 10 to 12 million women are using IUDs. The use of the method underwent a period of high expectations and considerable popularity in the mid-1960's. It then suffered a recession, particularly in developing countries, from which it is perhaps emerging. Only recently have newly shaped devices become available for use by women who have previously had no pregnancy.

2.3 Oral contraceptives (the "pill")

The pills used most frequently today consist of a combination of powerful hormonal drugs whose main action is to inhibit ovulation. Taken according to prescription, the oral contraceptives are virtually 100% effective. In actual fact, the reliability of women in taking a daily pill is limited, and this can lead to a considerable number of pregnancies.

Although the doses required for contraceptive purposes have been considerably reduced over the past decade, the ingredients of the pill still exert effects on many parts of the body in addition to their contraceptive action. The most dramatic of these side effects is undoubtedly blood-clotting accidents, often leading to death. These are rare, but have elicited much publicity. A range of other side effects have been documented, such as effects on blood pressure, on breast milk, and on the handling by the body of sugar and fat. Complaints of headache, nausea, changes in mood, weight gain, etc. have been associated with the use of oral contraceptives. The significance of these symptoms for the health of women is not clearly understood. Moreover, most studies of the effects of the pill have been carried out in North America and Western European women; whether the results are valid for populations of different genetic constitutions, diets, body-size, and often with the added complications of malnutrition and parasitic diseases, is not known.

Fears of cancer have dissuaded some women from the use of oral contraceptives, although such fears are not backed by evidence. There is also considerable fear of the effect of the pill on subsequent fertility, although in the great majority of women previous levels of fertility are restored after ceasing use of these contraceptives.

In spite of all these drawbacks, the pill probably represents the most revolutionary advance in contraception made in modern times. At least 25 to 30 million women are at present using this method, and appear to be satisfied by the fact that they can control their reproductive behaviour with a highly reliable method involving no more than a daily pill.

A different type of oral contraceptive containing only progestin, one of the two hormones present in the combined preparations just described, has recently been made available again for public use. Several preparations exist which consist of different kinds of progestins. They had been removed from the market after experimental animals (beagle dogs) developed breast nodules following administration of one of the preparations. Whereas the "classical" pill is taken only for three out of the four weeks of the monthly cycle, use of the progestin pill is simpler, since it is taken daily without interruption. Its effectiveness is lower than that of the classical pill, and strict adherence to the regimen is essential.

The general impression is that the pills containing progestin only have fewer side effects than the combined preparations, with respect for instance to blood-clotting, lactation, sugar metabolism. However, menstrual cycle variability and irregular bleeding occur in about 20% of users. The basis for the contraceptive action of these pills remains unclear. Unlike the "classical" pill, they do not inhibit ovulation in about two-thirds of women who use them.

2.4 Injectable drugs

It is claimed by many that there are several advantages to an injectable contraceptive: the alleged popularity in certain parts of the world for treatment by injection and the assurance that a subject has received contraceptive protection. There is only one widely studied compound "Depo-Provera" (medroxyprogesterone acetate). It has been investigated in more than 14,000 women in all parts of the world, principally in the form of a three-monthly injection. The pregnancy rate is uniformly very low, comparing favourable with the best effectiveness of the oral contraceptives (0 to 0.35

per 100 women years). Here again, a major drawback is the disruption of the normal menstrual cycle; irregular bleeding occurs at totally unpredictable intervals, especially during the first six months of treatment. Menstruation ceases in one-half to three-quarters of women after one year of use. This may be acceptable to some women, but may prejudice others against the method. The medical consequences of the cessation of menstruation are as yet unknown. A major concern about this method has been the reversibility of effects due to discontinuation of the method. In the majority of women, resumption of ovulation and fertility seem to occur within one year, but an element of unpredictability remains. This would limit the use of the method to women who intend to bear more children, unless other contraceptive techniques are unsuited or contraindicated for them.

Although based on few studies, the drug is claimed not to interfere with lactation, a fact that is important in developing countries. Weight gain and disturbances in the metabolism of sugar are associated with its use. For a drug as widely studied clinically as Depo-Provera there is a disturbing lack of research on its side effects, metabolism, and mode of action in the human. An unresolved problem which has curtailed the availability of Depo-Provera for contraceptive use is the increased incidence of tumours in the breast of beagle dogs during toxicity studies. The relevance to man of these nodules is not known.

2.5 Male and female sterilization

Fertility in the male and female can also be controlled by surgical methods. Vasectomy is a surgical procedure which consists in cutting and tying the spermatic duct to prevent the sperm from entering the ejaculate. In this operation no sex gland or organ is removed; thus the production of male hormones or androgens is unimpaired. The surgical techniques employed for women all involve operations on the uterine tubes which result in their occlusion. Sterilization as a method of contraception is virtually 100% effective. For all practical purposes these operations are considered irreversible and are used primarily when desired family size has been reached, and not as a method of child spacing.

It is obvious that surgical skills are required to carry out these procedures in both men and women, but the operation is simpler in men and requires less in the way of facilities. A mortality risk for female sterilization of the order of 25 per 100,000 has been quoted; this figure overemphasizes the hazards since it is based on sterilizations carried out in conjunction with other surgical procedures. In the male, the risks of surgical complications are very small, but the long term physical and psychological consequences have not been well studied.

Sterilization is one of the principal methods in the national programmes of several developing countries, where it is estimated that a total of 15 to 20 million procedures have been carried out in men and women. Figures in more developed countries are less precise but probably range between 5 to 10 million.

2.6 Induced abortion

Induced abortion is a method of birth control that has been used by women since time immemorial in all parts of the world. Until recently the great majority of abortions were performed outside the medical setting, usually by the introduction of a foreign body into the uterus by the woman herself or by untrained persons. The commonest medical method to bring about interruption of pregnancy is dilatation of the cervix and curettage of the uterus. Vacuum aspiration as a technique for emptying the uterus has gained increasing popularity. Both methods are used primarily during the first three months of pregnancy.

The extent of morbidity and mortality associated with induced abortion is closely related to whether the procedure is performed in a medical setting, and this in turn is primarily determined by socio-cultural and legal prescriptions. In this regard, there has been a marked trend in the past twenty years towards the legalization of abortion; this has been accompanied by a broadening of the acceptable indications for termination of pregnancy from restricted medical and psychiatric indications to wider social considerations, including simply the request of the woman for abortion.

Estimates of mortality from abortions performed outside the medical setting reach in some communities 1,000 per 100,000 illegal abortions. This contrasts with figures of 3 to 5 deaths per 100,000 legal abortions performed during the first three months of pregnancy.

Information is far less adequate on the frequency of non-fatal complications, either occurring immediately after abortion, or as the result of repeated abortion, even when performed legally in a hospital setting.

It is impossible at present to produce a reliable estimate of the total number of induced abortions throughout the world, since the majority are performed clandestinely. In recent years, induced abortions have exceeded live births in several countries with low birth rates. In many less-developed countries with high birth rates, the number of abortions per 1,000 live births is low. About one-half of the world's population lives in countries where abortion is permitted for broadly interpreted social indications, or at the request of the pregnant woman. Where statistics on legal abortion are published, the ratio is generally above 300 per 1,000 live births.

3. Current research and development on methods of fertility regulation

Current research and development follow two main approaches: to improve existing methods, and to develop new technology. Efforts toimprove contraceptives range from relatively small changes in dosages of drugs, or the shape and composition of IUDs, to more ambitious attempts at altering drugs and formulations to extend considerably their period of efficacy, e.g. the once-a-month pill, and to providing new routes of administration, e.g. injectable preparations. The aims are to increase appeal of the method, simplify use, decrease side effects and increase efficacy, ensure cultural acceptability, and keep manufacturing and distribution costs to a minimum. These same objectives have guided the search for new methods which, in addition, will fill the most obvious present gaps in contraceptive technology.

This section provides an overview of current activities and potential future developments.

3.1 Traditional behaviour and locally applied methods

A simple and cheap method for the accurate prediction of ovulation would greatly improve the reliability of the rhythm method. Relatively little attention is being given to developing the materials required (e.g. a substitute for the thermometer), in spite of the considerable advances made in understanding the biology of ovulation and the menstrual cycle.

The controlled induction by a drug of monthly release of the ovum from the ovary represents another approach to rhythm contraception. The recent isolation of additional hormones involved in the regulation of ovulation urgently require to be applied towards this end.

For condoms, emphasis has been placed recently on presentation (e.g. attractive colours) of the product, and by facilitating use by packaging pre-lubricated condoms. An attempt to substitute plastic for latex in their composition has met with little success.

Some effort has gone into developing dissolving films for applying intravaginally spermicidal agents. One of the versions that is being at present tried out is a two inch square of film that can be either inserted manually into the vagina prior to intercourse, or can be carried into it by placing the film on the penis. Further study is required to determine its efficacy. It also suffers from the disadvantage of requiring continued motivation.

To overcome this drawback, research is currently under way on vaginal rings, that release antifertility drugs over an extended period. Such devices could be inserted and removed by the user; and their effectiveness could last for a period of a month, or even longer. Different drugs and plastic rings need to be studied. The action of the drugs might be to inhibit ovulation or to stop sperm from entering the womb.

Closely related are early research and development efforts on intra-cervical contraceptive devices (ICDs). The aim is to produce a device that can be retained in the cervix for prdonged periods of time without blocking menstrual flow and that will, by its physical properties, or if medicated, disrupt the movement of sperm through the canal.

ICDs and vaginal rings have the potential advantage over IUDs of requiring less skill for insertion.

3.2 Intra-uterine devices

Continued efforts are being expended to modify the size and shape of IUDs, and the composition of their materials, in order to increase their effectiveness, lower expulsion rates, and reduce associated pain and bleeding. Unfortunately, only very few of these devices are being studied in comparison one with another, and in several centres.

Another line of research and development in IUDs is to use them as carriers for chemical substances or drugs which exert an antifertility effect. The smaller size of these "second generation" IUDs compared with the devices presently in use that exert their effect through their mechanical properties, facilitates insertion and reduces the frequency and severity of side effects. The most promising and best studied of these new devices is a T-shaped plastic IUD that carries a small quantity of copper.

The devices that release drugs in the uterus illustrate a current trend in contraceptive research. Increased emphasis is being placed on devising means of releasing drugs in minute quantities at a continuous rate as close as possible to the organ on which the drug acts. This local release reduces side effects, since it permits the use of much smaller quantities of drugs and essentially restricts the drug to a single organ or tissue.

Research on these improved delivery systems for contraceptive methods is not limited to IUDs (see vaginal rings and intra-cervical devices, Section 3.1). It requires a considerable development effort at the bioengineering level, particularly with respect to evolving safe plastic materials and polymers that permit controlled release rates of drugs in the body.

3.3 Oral contraceptives

3.3.1 Modifications of "the pill" - combined preparations

Under the generic name of "the pill" a variety of different quantities and combinations of hormonal steroids are included. Dramatic reductions in the amounts of the substances have, without impairing the efficacy of the preparation, been achieved over

the last 15 years. The reductions in the amount of the substances have been accompanied by a considerable decrease in side effects. It has been established that the risk of thromboembolism is significantly less at lower oestrogen doses, and the same applies to several of the minor side effects. Current clinical research continues to assess the possibility of still further reductions in drug dosages. At the same time, investigations are focussing in greater detail on the side effects that each of the components give rise to, either individually or in combination. This aims at arriving at preparations that would meet the needs of different populations.

3.3.2 "Once a month" pill

The advantages of a contraceptive that would only need to be taken twelve times a year continue to stimulate research. Several hormone-like preparations are known that are stored in body-fat after ingestion and provide contraceptive effect through slow release during thirty days. Clinical studies carried out in several countries have shown one of these preparations to be promising with regard to effectiveness, but requires further confirmation. This preparation combines a long-acting oestrogen and a progestogen, both of which differ from the ingredients of the "classical" pill. The side effects include variation in the length of the menstrual period and heavier than normal bleeding. Considerable efforts to overcome these disadvantages and to obtain data on metabolic effects are required before this approach can become available for widespread use.

Research is also proceeding on a "once a week pill".

3.4 Injectable preparations and implants

The main research efforts with the injectable contraceptive hormones have been directed towards extending the period of efficacy of Depo-Provera (see Section 2.4) from 3 months to 6 months by increasing the dose. The effectiveness of the 6-month regimen seems to be a little lower than that of the 3 month one, yet is associated with the same side effects. Surprisingly little research is being carried out on other injectable compounds, and on making their mode of administration easier.

Another approach to long-acting contraception is through the use of plastic capsules that can be inserted under the woman's skin to release hormones at low and constant rates. Effectiveness for a full year has been demonstrated in limited clinical studies. One of the further aims is to develop capsules that could release drugs over 3 or 5 years, or even longer periods. Removal of the capsule would require a minor local excision. Side effects would depend on whatever hormones or other drugs are used in the capsules.

3.5 Post-coital pills

A method of birth control that might be used after, rather than before, intercourse would meed the needs of certain individuals: for instance, those whose relatively infrequent intercourse does not justify the use of "continuous" methods such as the pill or the IUD, or those who have inadvertently omitted to employ their usual contraceptive. High doses of oestrogens, administered within three days of intercourse, appear effective, but are associated with disturbing side effects, and this approach is unlikely to be acceptable except in a rare emergency situation. A small number of other drugs are currently being examined as potential post-coital agents, but their efficacy and mode of action remains to be determined.

3.6 Induced abortion

Research on improved methods of induced abortion stems from the recognition that this is, and is likely to continue to be, a widely used method of birth control in many societies, e.g. in cases of failure to use a contraceptive, or because of the lack of 100 per cent effectiveness of most contraceptives available. A completely different argument has recently been brought forward; it states that the safest and most effective approach to birth control may well consist in using methods of contraception (e.g. the diaphragm or condom) less effective than the modern methods (e.g. the pill and IUD), but free from their serious side effects, and combining this with safe termination of those pregnancies that occur through failure of the method or its improper use. (Safe termination of pregnancy implies the availability of trained personnel and adequate facilities.)

3.6.1 Drug-induced abortion

Recent research on prostaglandins is giving a considerable impetus to the development of drugs for the termination of pregnancy. Prostaglandins have, to date, shown some effectiveness in the termination of pregnancy during the 3rd to 6th months (second trimester of pregnancy) by causing contractions of the uterus and expulsion of the fetus.

Since second trimester abortions present increased health hazards, much greater efforts are being expended on exploring the use of prostaglandins for induction of abortion during the first trimester. A major objective is the development of a prostaglandin "pill"; it might be taken either monthly on a regular basis, at the time of expected menstruation and without any attempt to find out where pregnancy has occurred, or would be reserved as a "back-stopping" method for those months when menstruation was delayed, and pregnancy suspected. Modified prostaglandins, so called analogues, appear to be more effective than the naturally occurring substances, and considerable research efforts are focussing upon them.

A number of other potential oral abortifacients have been studied but abandoned either because they were toxic or caused malformations in the fetuses which were not expelled. Presumably the plants used for the induction of abortion in folk medicine should be devoid of such toxicity; however, none so far have been shown to be effective upon careful pharmacological assessment in small laboratory animals. Perhaps this is an area deserving more systematic and intensive effort.

3.6.2 Mechanically induced abortion

Although mortality and morbidity associated with first-trimester termination of pregnancy by mechanical methods, in particular vacuum aspiration are low, too little attention is given to further improving the technology. The aim would be to evolve better instruments in order to minimize injury to maternal tissues, avoid infection and reduce blood loss. At the same time, the developing countries wanting to provide this method in their family planning programmes require design of equipment, e.g. pumps, that will be suited to different service settings, simple to use and maintain, and cheap.

3.7 Sterilization

3.7.1 In women

One of the main limitations to widespread access to surgical sterilization for women has been the need for hospital facilities and skilled medical personnel. Other deterrents to its use include the attendant pain and abdominal scarring.

Instruments have been developed that permit occlusion of the oviduct by insertion through the vagina. This appears to shorten the period of convalescence, the need for anaesthesia, and has done away with external scars, although it still requires the introduction of an instrument into the abdominal cavity. Specialized medical skills are needed. For this reason, research has been directed to instillation of chemicals and mechanical plugs through the uterus to occlude the oviduct. It involves developing simpler systems for the delivery of these materials, possibly by less highly skilled personnel. Some promising studies have been carried out in humans, but a great deal more work on the occluding materials, and the permanence of the effect, is required.

3.7.2 In men

The accent in research and development on male sterilization has been on both improving the reversibility of the procedure, and eliminating the need for surgery. Many approaches are being studied in experimental animals and man. Clips that constrict the spermatic tube and that can be easily removed have been designed, as have intravasal valves that can be operated manually or magnetically. Plugging devices of various shapes and materials, inserted in the lumen of the vas deferens, are being tested. To date, all these devices are associated with unacceptable side effects, uncertainty about the results of prolonged use, and technological difficulties.

3.8 Contraceptive drugs for men

Research and development of contraceptive drugs for men is receiving disproportionately little attention. Part of the reason may well be the fact that there is a smaller number of steps in the male reproductive process susceptible to regulation: sperm production in the testis, sperm maturation and transport in the sperm ducts. To

date, all drugs shown to inhibit sperm formation have been associated with undesirable side effects, particularly on libido. To overcome the latter effect, the use of testosterone, the male hormone, in combination with other contraceptive agents, is being explored in the form of pills, injections and implants under the skin.

Another approach is the search for compounds that interfere only with the maturation of sperm, but not their formation.

3.9 Other approaches

The idea of a vaccine that would immunize against ova or sperm, or against the initiation or maintenance of pregnancy itself, has for a long time held much appeal. Although this approach has met with some success in animals, the vaccine preparations have not been of sufficient purity to allow use in humans. The questions of reversibility, effects on other organ systems, or long-term effects have so far remained unresolved. Recent advances in the isolation of purified proteins of the reproductive tract have renewed interest in the immunological approach.

The search for new methods is continuously being extended. For example, it was found, first in insects, then in mammals, that the smell of certain substances given off by one sex affected the reproductive processes and behaviour of the other. In some rodents, for instance, ovulation and implantation can be inhibited by volatile substances released by some males. The ubiquity of these substances in the animal kingdom, including primates, is stimulating research on their application in the human.

4. Steps in developing new methods

Any decision on investment in contraceptive research must take into account the steps involved in the development of every new method. Each step requires a different input in terms of such resources as knowledge, skilled manpower, facilities, equipment, administrative and organization structures, time and funding.

The sequence of these steps is described under the following headings:

1. Characterizing methods that will be acceptable to people, and practicable for family planning programmes.

2. Identifying the relevant reproductive processes or target organ, amenable to control.

3. Translating the biological intervention into its practical application: drug and delivery system, mechanical device, surgical procedure.

4. Evaluating the method in the human: effectiveness and safety.

5. Assessing acceptability and marketing.

4.1 Characterization of methods

Most drug development starts with little consideration of the acceptability of the measure to the individual who is to use it. Over-riding importance is given to the therapeutic effect, and little or no effort is devoted to developing a variety of methods related to individual convenience. The specification of objectives in contraceptive research has in general been governed by two approaches: one is primarily biological, and is based on processes susceptible to regulation; the other consists in a search for the "ideal" contraceptive that meets the much reiterated tag-phase criteria of high effectiveness, absolute safety, total simplicity, reversibility, and low cost. What has been clearly lacking at this stage of contraceptive development is solid consumer research to define the attributes of the methods affecting their potential use in different socio-cultural and economic settings towards which the biopharmacological research should be directed. First stage consumer research could also identify properties affecting acceptance and use in different cultural milieus at different life stages of individuals and couples. These include such characteristics as use by the man or woman, the timing of use in relation to intercourse, frequency of use, route of administration, the manipulation required, the perceived effects on health as well as the cultural interpretation given to side effects.

Practical considerations on the service delivery of methods, e.g. need for personnel, cost, facilities, should also enter at this initial stage in the specification of methods to be developed.

Certain alternatives will be ruled out by using this approach. At the same time, much unnecessary effort will be avoided, and cost and time saved by giving attention to the behavioural and practical attributes of methods that will determine their use.

The greatest obstacle to consumer research at this first stage of contraceptive development has been the failure to recognize its importance. Another limiting factor is the difficulty of behavioural research in general, and particularly in the field of human sexuality. There are very few scientists concerned with these biosocial aspects of fertility control, and the methodology for these studies is still in its infancy. Application of good marketing research at this predevelopment stage could, nevertheless, be fruitful.

4.2 Identification of reproductive processes amenable for control

Having decided on the types of new contraceptives to be developed, the next step in a systematic programme would be to identify one or more events in male or female reproduction that would lend themselves to regulation by the method. Some advances have been made in the last thirty years in our understanding of major processes of reproduction susceptible to fertility regulation:

(i) the formation, maturation and transport of sperm;

(ii) the transfer to, and migration of sperm, in the female genital tract;

(iii) the formation, maturation, release, and transport of ova;

(iv) the transformation, i.e. capacitation, of sperms in the genital tract, and fertilization;

(v) the transport of the fertilization ovum, and its implantation;

(vi) the development of the embryo and fetus

However, understanding is still at a relatively rudimentary level about each of these processes, their relation one to the other, and their interaction with other body systems. There are great gaps in knowledge of the structure, function and regulation of processes involved in reproduction, at the molecular level, in cells and tissues, and in the whole animal. It is noteworthy that even the mechanism of action of such well-established methods as the pill and IUDs remains poorly understood.

Clearly, if we are to speed up contraceptive research and development, greater expenditure of effort in research on reproductive biology is indispensable.

More scientists are needed, and from many more disciplines than those at present engaged in this field. Suitable career opportunities and better laboratory facilities would help draw scientists to it, and possibly realize to the full its intellectual challenge. There continues to be a discrepancy between the amount of research carried out in animals and in man. The value of animal data is unquestioned and indeed some animal studies require extension to previously unstudied species, but the difficulties of extrapolating the findings to man are such as also to justify a far greater research effort on the normal processes regulating reproduction in man.

A strategy issue in achieving better understanding of reproductive processes amenable to control centres on the relative merits of two possible approaches, namely the conduct of such research within the framework of a goal-oriented contraceptive effort, such as is carried out in some pharmaceutical firms, or using the undirected approach characteristic of academic settings.

4.3 Translating the biological intervention into its practical application

Once possible areas susceptible to control have emerged from research, a number of steps have to be gone through before the product is ready for its first trial in human subjects. These steps may be illustrated by reference to the development of a new contraceptive drug.

The project starts with the selection of a type of chemical substance thought to be likely to interfere with the reproductive process it is desired to control. A programme of chemical synthesis of small amounts of several compounds is started. The initial screening for their antifertility effectiveness in animals may require the development of simple tests. The most promising compounds will be synthesized in larger amounts for study of the mechanism of action and the handling by the body of the substances.

The drugs that have passed successfully through these tests are then ready for the toxicological studies in animals that precede the first test in man. The requirements

for these studies have usually been laid down by national regulatory bodies and may differ from country to country with respect to types and numbers of tests, number of animals and species involved, and the duration of testing. The extent of testing is also determined by the nature of the drug: for instance, whether it is administered on a short- or long-term basis, or whether it will circulate throughout the body or be applied locally to the reproductive organ. The tests help to provide guidance on the maximum tolerable dose and duration of administration, and the side effects that need to be watched for. The study is also begun of possible congenital malformations that might result if the drug fails to prevent conception or is administered inadvertently to the pregnant female. While these toxicological tests are proceeding, pharmaceutical work will proceed on the formulation and tableting of the compounds.

4.4 Evaluating the method in the human

This assessment (clinical trials) is generally divided into four phases that examine in turn different aspects of the method: gross tolerance, contraceptive effect and gross side effects, contraceptive effectiveness and incidence of side effects, and continuous surveillance for side effects once the product is marketed. The numbers of patients involved in each of these trials becomes larger as they proceed from Phase I to IV: in Phase I trials, about 10 subjects will be involved in whom there can be no risk of pregnancy; in Phase II, about 50 to 100 healthy subjects of proved fertility; in Phase III, 500 to several thousand individuals; and in Phase IV the entire population at risk. As for all research involving human subjects, the provisions of the Helsinki Convention on the protection of those involved, or similar national legislation, apply.

The studies undertaken in the earlier phases are elaborate and require sophisticated laboratory techniques. The tests carried out in each phase demand complex study designs and methods of analysis. In most countries, the data are submitted for consideration by the regulatory agencies. A persistent problem is the need to follow all women participating in these trials for prescribed periods of time, even those who abandon the method. Efforts should also be made to study the fertility of subjects who have discontinued the method, and even the growth and development of their offspring.

These clinical trials last about four to five years before widespread use is permitted. Throughout this period, longer-term studies of toxicity in animals are likely to be required, and are usually continued to investigate chronic effects. Both clinical trials and the continued toxicology testing, depending on the nature of the method, may entail expenditures ranging up to 10 to 15 million dollars.

The requirements for contraceptive testing are considerably more stringent than for other therapeutic agents. This is usually justified on the basis that these methods are used mainly by healthy subjects without continued medical supervision, over long periods of time, who may wish for subsequent pregnancies, and for whom alternate methods of contraception are available.

The magnitude of research needed to meet these requirements is having an increasingly negative effect on research and development of new contraceptive drugs. The decreased interest and activity in industry, for example, is attributed to the costs involved and the duration of testing, especially since the latter begins to approximate the period of patent exclusivity and thus the opportunities of higher returns on investments. Moreover, from the scientific viewpoint, the value, for example, of much of the animal testing for predicting the effects of the drugs in humans is far from established. Most of these requirements have been introduced during the past ten years. The whole question of extrapolation of animal data to man requires much further study.

There remains other intrinsic problems in evaluating new contraceptives: securing the voluntary participation of large numbers of subjects for study, the length of time before certain side effects will appear, the numbers of individuals required to demonstrate a cause-effect relationship for an increase in a rare side effect, the difficulty of analysing the interaction between contraceptive agents and other drugs. Moreover, the dose determined for effectiveness in one population may be too high or too low in another, and unexpected side effects occur in populations differing nutritionally. Such uncertainties could be resolved at an early stage of evaluation through the conduct of multi-centred trials using the same research design. The pursuit of the required research

and development is also hampered by shortages of skilled personnel in some areas: experimental and clinical phramacology, bioengineering, clinical trials methodology, and epidemiology.

Some consider that the insistance on absolute freedom from side effects is unrealistic in that any therapeutic agent is likely to be associated with side effects. The question becomes one of relative risk in which the incidence of side effects from a given method must be compared with risks from alternative methods or from unwanted pregnancy.

4.5 Acceptability and marketing

It is obvious that the acceptability and successful use of a method will depend on many factors, including to a large extent the sources or services from which it may be obtained. This involves considerations of use in family planning programmes and operational questions that are dealt with in a later section of this paper. However, certain characteristics of products, such as their size, colour, taste and form may considerably affect the acceptability of a method. Research on these attributes is carried out through marketing studies and constitutes the end stages of the development process.

5. Organization and funding of research

Research and development on methods of fertility regulation are presently carried out in four settings: the pharmaceutical industry, universities, government and private research institutes, and various clinical facilities.

5.1 The drug industry

The approaches taken to research by these different institutions vary considerably. That of the drug industry involves a highly organized and directed team effort towards the development of a specific product. This effort is self-supporting, of considerable scale, and attempts are made to monitor it carefully from stage to stage. Industry, however, generally has no facilities for clinical assessment and relies on clinicians in university and other hospitals and on private practitioners for the clinical trials, largely on an ad hoc basis. With the increasing requirement for long-term toxicological studies, industry has also begun to contract out this work to specialized concerns.

5.2 Universities

Traditionally, research activity in this field constituted a very small part of the universities' total research until about 10 years ago. Even now, it is of small magnitude, is largely concerned with reproductive biology per se with little attention to applications to fertility control. As in most undirected research, its course has been largely determined by the personal interests of the senior investigators. This quest for knowledge for its own sake has undoubtedly contributed greatly to understanding of reproductive processes. Some medical schools have also been involved in clinical trials of birth control methods and in other aspects of applied research. University research, in this field as in others, derives a large part of its support from government sources. Public pressure for more tangible and practical returns for the investment of its funds may well increase the proportion of applied research. This changed outlook has also led to recent attempts to involve scientists from idfferent institutions in organized goal-oriented collaborative efforts. These multi-institution "task forces" are directing themselves to many of the steps involved in the development of methods outlined in Section 1.4. An attempt is made at the same time to foster collaboration between these task forces and industry. A parallel effort is to build up within a single academic institution a multi-disciplinary group of scientists concerned with research in this field; an underlying assumption to this approach is that greater pay-off may be expected from a large number of scientists, the "critical mass" concept.

Support is usually provided in the form of relatively short-term grants and contracts, usually for one or two years. Longer contracts may be given to special units, such as those supported by medical research councils. Half-a-dozen university chairs in reproduction have been established.

5.3 Government research institutions

Contraceptive research and development is found in three types of governmental institutions: those of national medical research councils, of national family planning programmes, and of drug regulatory agencies. The first are very similar, in structure

and scope, to academic institutions; the Indian Council of Medical Research, the National Institutes of Health of the United States of America and the research Institute of the Mexican Social Security Scheme have such specialized programmes. They are predominantly interested in problems of general reproductive biology rather than contraceptive development.

This contrasts with the activities of the few institutions established to provide a biomedical research base for national family planning programmes. Here the stress is on laboratory and clinical studies designed to assess the side effects of the contraceptives used in the family planning programmes: such institutions are being established, for example, in Pakistan and Iran. They may also carry out studies of the mode of action of new methods.

Lastly, in addition to quality control and testing, the research facilities of a few regulatory agencies are engaged in investigating different approaches to contraceptive toxicology.

5.4 Private research institutes

Some contraceptive research and development is carried out in private institutions: for example, the Biomedical Division of the Population Council (an organization in the US supported by private foundations and government contracts) has explored a number of ways of improving existing contraceptives and developing new ones. Much of the work on the contraceptive pill took place in another private biomedical research institution, the Worcester Foundation for Experimental Biology which also had an active research training programme in reproduction, as well as undertaking research in other fields.

Yet another type of private non-profit making institution has become active in the field: such institutions use the management approach characteristic of industry, and, under contract from government agencies, industry and private foundations, apply themselves to specific problems in contraceptive research and development.

5.5 Clinical facilities

A good deal of clinical trial work has been carried out in university and other hospitals, family planning clinics and by private practitioners, usually individually,

on occasion within the framework of professional societies. Many of these have been well planned and carefully supervised, but, in an appreciable number, efforts have been wasted through failure of the clinician to understand the principles of clinical research.

To improve the quality of this important phase of contraceptive development, support is being given to a network of clinical research groups in many countries that have agreed to collaborate in clinical trials using a common protocol. This should avoid the confusion that has arisen in the past when a drug was often assessed through different study designs, and should also serve to indicate quickly the differences or similarities in the response of different populations to a given contraceptive.

6. Funding

Fairly accurate estimates are available of the annual overall funds going to support contraceptive research and development, including reproductive biology. In 1972, the total amount[1] approximates $110 million, with roughly $50 million spent by industry, the same amount by government sources, and $10 million by private foundations. The $50 million expended by the public sector represents a marked increase over the $6 to $7 million allocated to this field in 1966. Although the major part of the government funds still come through the channel of the Medical Research Councils, technical assistance agencies of several countries also now devote part of their budget to this problem. The largest overall public expenditure for contraceptive and reproduction research is that of the United States which is said to be insufficient to meet applications for support; certainly the $40 million budget in this area is dwarfed by the sums allocated to other forms of biological research. Other countries, such as Sweden, have also increased governmental contributions to contraceptive research.

These increases may, to a certain extent, be neutralized by the gradual withdrawal from this area of research of many in the industry, due to the alleged high commercial risk. To maintain industry's momentum in certain countries, government funds have been made available, up till now in the form of limited research contracts. This use of public money inevitably raises questions of patent rights. Some leaders in industry have urged more flexible royalty arrangements, whereby new products developed by government funds

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[1] Figures for the People's Republic of China not available

would be provided on a cost basis in the public sector, and would allow a profit margin in the private sector. A few drug manufacturers have gone so far as to suggest programmes of shared risk between government and industry, especially for toxicological and clinical studies. Industry's research potential might also be tapped, through government subsidies, to develop so-called non-commerical products, i.e. cheap, non-prescription drugs and devices, an area in which the drug industry is unlikely otherwise to show much interest.

Much credit for obtaining recognition of the importance of reproduction research goes to the Ford Foundation; this private organization has spent more than $100 million for research and research training in this field over the past decade.

This review of current funding leads naturally to the questions of how much we should spend today and in the next ten to twenty years? A considered answer would be based on a detailed strategy that would take into account the relative merits and mixes of directed and non-directed research, of short and long term pay-offs, of investment in research training, of directing efforts to male or to female contraception, and of different methods. Partial answers can at present be given to some of these questions and continuous attempts should be made to refine the strategy. However, these questions touch on broad issues of research strategy which have not been fully resolved in any field. Indeed, the different strategies are likely to be primarily determined by the level of funding available. This in itself will be a reflection of the importance given by society to this problem, just as the development of effective anti-malarial drugs, or travelling to the moon reflected other priorities and led to these achievements.

THE NECESSITY OF NATIONAL POPULATION POLICIES

report of a study group within the Swedish Pugwash Organization by Birgitta Linner (Chairman) and

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A. Introduction

Since at least two decades the rapidly increasing population of the world has been a cause of anxiety and concern for many organizations and individuals. It is now widely accepted that the increase must be brought to a halt if the resources of the world should make a reasonable standard of living attainable for all people.

We are, however, also told that the resources increase all the time, because new technology brings redefinitions of what represents a resource. We are told that a population much larger than now predicted for the next century will not only survive, but live in affluence.

The conflicting forecasts may confuse us, but there is one ultimate and conclusive argument against the calculations which promise a bright future: they have been made before and they have not been true. We know that a large part of the world population suffers from malnutrition, in particular a large part of the children of the world and that a number, larger than ever before, is affected beyond recovery.

Many organizations have advocated family planning and many programs have been started but still the population of the world increases more rapidly than ever.

Consequently, the size of the world population is now one of the most important global problems. Nothing has yet been able to slow down the increase. It is urgent to find ways to reduce population growth and to use all scientific disciplines for the study of this subject.

B. Recent policy statements on a world-wide scale

Several world organizations have expressed their serious concern about the population problems. We quote here a few examples of statements issued by UN and by spokesmen for two of the world's great religions.

United Nations

General Assembly, resolution 2211 of December 1966, recognized "the sovereignty of nations in formulating and promoting their own population policies, with due regard to the principle that the size of the family should be the free choice of each individual family".

UN Conference on Human Rights, Teheran 1968: "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 ....." .

General Assembly, resolution 2542, December 11 1969: "Parents have the exclusive right to determine freely and responsibly the number and spacing of their children", recommending inter alia "the provision to families of the knowledge and means necessary" to enable them to exercise that right.

General Assembly, resolution 2716, entitled "Programme of concerted international action for the advancement of women", December 15 1970: "Making available to all persons who so desire the necessary information and advice to enable them to decide freely and responsibly on the number and spacing of their children and to prepare them for responsible parenthood, including information on the ways in which women can benefit from family planning. Such information and advice should be based on valid and proven scientific expertise with due regard to the risks that may be involved".

UN Conference on the Human Environment, Stockholm June 1972, stated in its Declaration that "16. Demographic policies, which are without prejudice to basic human rights and which are deemed appropriate by Governments concerned, should be applied in those regions where the rate of population growth or excessive population concentrations are likely to have adverse effects on the environment or development, or where low population density may prevent improvement of the human environment and impede development".

Recommendations by the first committee ("Planning and management of human settlements for environmental quality") adopted by the Conference: "154. It is recommended that the Secretary-General ensure that during the preparations for the 1974 World Population Conference, special attention be given to population concerns as they relate to the environment and, more particularly, to the environment of human settlements".

"155. It is recommended that WHO and other United Nations agencies should provide increased assistance to governments who so request in the field of family planning programmes without delay. It is further recommended that WHO should promote and intensify research endeavour in the field of human reproduction, so that serious consequences of population explosion on human environment can be prevented".

NB: World Population Year 1974, with a World Population Conference to be held at UN headquarters in New York August 19-30.

Among UN organisations concerned with population and family planning are:

UN Secretariat
UN Development Programme/UN Fund for Population Activities
FAO, ILO, Unesco, Unicef, WHO
UN Population Commission
UN Commission on the Status of Women

World Council of Churches

Statement by Executive Committee, September 1971, Geneva:

"6. Family planning, the voluntary spacing of children by contraception or other means, is a necessity, but it is not the same as population control. Even with universal family planning, populations may continue to grow because people want large families. It has been a cardinal assumption that any list of human rights should include the right of parents to decide on how many children they might have. But this right should not be exercised apart from the right of children to physical, social, and psychological health, to an environment which gives scope to the fullfillment of their human potentialities. Population control puts the emphasis on parents having the number of children that can be adequately cared for in the world, rather than on the number of children parents may want to have. If such control is to be achieved voluntary, we must have better knowledge of the complex reasons why people desire large families. Experience with different types of incentives is needed. Routes to control along these lines will be long and arduous, but must be followed".

The Roman Catholic Church

In October 1966, Pope Paul VI called upon the UN to ensure "enough bread on the tables of mankind and not encourage artificial birth control".

Encyclical letter (Populorum Progressio), March 1967: "It is true that, too frequently, an accelerated demographic increase adds its own difficulties to the problems of development: the size of the population increased more rapidly than available resources, and things are found to have reached an impasse".

Encyclical letter on the Regulation of Birth (Humanae Vitae), July 1968: "Illicit ways of regulation of birth. - - - Similarly excluded is every action which, either in anticipation of the conjugal act, or in its accomplishment, or in the development of its natural consequences, proposes, whether as an end or as a means, to render procreation impossible."

It is well known that many Church leaders, as well as laymen/women, have taken positions which differ more or less radically from that of the Pope.

Islam

As early as 1937, the Mufti of Egypt proclaimed: "It is permissible for either husband or wife, by mutual consent, to take any measures to prevent semen from entering the uterus, in order to prevent conception". Similar statements have been issued in recent decades.

Muslim specialists, gathered at a conference arranged by the Middle East and North African Region of the IPPF in Rabat, December 1971, stated that "the Sharia allows the Muslim family the necessary latitude for enabling it to regulate its life in such a way or ways as would lead to balanced procreation either for increasing or decreasing its size, and for helping parents to overcome the handicap of sterility and for spacing the incidence of pregnancy, making use in all such cases of safe and legitimate methods of contraception."

Private organisations

For example:

International Planned Parenthood Federation (IPPF), established in 1952, a federation of national family planning associations in 79 countries.

Population Council, established in 1952

Pugwash, see statement of Sinaia, 1971.

C. Population trends and limits to food production

The world population is growing at an increasing rate. The increase is now about 2 % or 75 millions per annum. The rate of increase has so far not begun to decline, but may do so in future as the mortality cannot decrease as rapidly, which the fertility could be expected to decline.

Estimates on how soon this decline can be expected vary, but all count on a continued increase beyond the turn of the century, reckoning with several thousand million people more already at the year 2000. Even if birth rates would rapidly decrease to the level of replacement, the increase would anyway continue long into the 21st century before levelling off at a still higher value. UN's lowest figure for the world population at the year 2000 is 6,1 thousand millions - an increase with 2,4 thousand millions or 65 %.

Also all available data tell that the food supply is unsatisfactory in many less developed countries (LDCs) and that no tangible improvement has occurred in the big LDCs. The development to date can easily be followed in FAO's yearly statistical records, now covering the period from 1952 to 1970. This makes it possible to see how the food situation has changed during a rather long period.

Some countries show substantive improvements, especially some small ones, like Cyprus, West Malaysia and Sarawak, the Caribbean countries and certain African states, like Togo and Upper Volta. These countries have gained an increase in the per capita food produc-

tion of 40 or 50, even up to 100 % during a 16 year period. At the same time, the averages for the big less developed regions show only slight differences from the mean of the 1952-56 period. For Latin America there is a 5 % increase, for South and East Asia a 10 % and for Southwest Asia a 4 % increase. Africa had a 5 % decrease. This means that the improvements in some countries are balanced by almost corresponding declines in other, more populous countries.

Food supply is thus inappropriate. Despite statements of optimism and hope, no real improvement has taken place during the latest 20 years. It might rather be spoken of as deterioration, as inadequate food supply now affects a larger number of people. This disconcerting situation raises the question: How many people can the world feed?

The biological primary production is (optimistically) 7,5 tons per hectare, taken as an average of fertile lands in all world regions (Resources and Man, p.83). If this production can be attained on all land including deserts, mountains and other less productive areas, 135 million square kilometers), if a quarter of all the primary production including wood stems, hulls etc could be used for human consumption, and if a dominantly vegetarian diet is accepted, then about 25 000 million tons of organic matter would be available for human consumption. The inclusion of grazing animals into the process gives a loss of organic matter of about 90 %. Hence animal products could not constitute more than a fifth of the diet. The contribution of the seas to the calculated upper limit is negligible: their total primary production is roughly the same as that of the land, but the producers and the herbivorous are mainly indigestible and close to unretrievable plankton. Thus man has to remain with the carnivorous of first or higher order, yielding about 1 % of the primary production in edible form. The quite hypothetical food quantity thus calculated would feed about 60 000 million people at today's caloric level. The actual limit to world population is obviously only a fraction of this, since the above calculation presuppores that a whole series of improbable assumptions can be fulfilled.

The production of the calculated maximum, 25 000 million tons of food per annum, without upsetting ecosystems, requires an enormous demand of knowledge about the self-regulatory capacity of the systems and their conditions for stability. Present knowledge is certainly not sufficient to say if this is possible. Such food production would also require a totally new "technology of agriculture". The present type would result in an environmental crisis limiting the amount produced to a much lower level. In e.g. the USA the result of an agriculture can be seen where methods are primarily guided by market and profit considerations: the environmental costs are considerable even if only half a person is to be fed from each hectare

of tilled land, in comparison to several people per hectare in many European and Asian countries with less soil erosion and pollution from agriculture.

Through history the limits to the number of people have, of course, been set by the available technology and the ability of the social organisation to utilize it. Hunting societies could not change ecosystems, but only catch some species of animals in competition with other carnivores. The people of these cultures therefore take a rather small niche in the ecosystem and get a much lower upper limit for their food supply. Before agriculture there were never more than a few million people on earth.

With agriculture, Man began chaning ecosystems, in order to utilize a larger part of the primary production of the land. Technology, however, limited early agriculture to light soils. With in principal unchanged agricultural technology from the beginning of the Iron Age to the 17th century, the world population was also amazingly constant - between 200 and 300 millions during about 2000 years.

Since then, ever new methods have enabled us to expand the cultivated area considerably, and improved varieties and methods of cultivation (primarily rotation systems and manuring) have multiplied yields per ha, so that the food is now (almost) enough for 3 700 million people.

The tilled land is now around 1 500 million ha. It is often estimated that 3 200 million ha at the most can be made arable, i.e. suitable for cultivated crops (of e.g. Resources and Man, p.67). The remaining half is in many ways much more difficult and thus more expensive to cultivate. Meanwhile good, agricultural land is withdrawn for building cities and roads. It is difficult to increase the use of fertilizers as they already are causing soil erosion or ground water pollution in many areas.

The use of higher-yield varieties also seems to be a hard way to go. Those introduced in the so called "green revolution" may have increased some harvests but - in 1969 - still not enough to change the trend of regional or large country averages. If the 1952-56 mean is 100, India's per capita food production was 104 in 1969, Pakistan's 104 and that of the Philippines 98, which are small changes in a 16 year period. We also now know that they exhaust all but the best soils and that the high amounts of pesticides they demand are in the long run a danger for the ecological cycles.

It seems as if we are closing in on a limit to the increase in food production, although we only produce a sixteenth of the amount theoretically calculated above

There are, however, some untried methods of increasing the harvests. Especially, many more plant species than those favoured now should be possible to use. An expansion of soybean cultivation at the expense of wheat should improve the protein supply and halt destruction of some soils. Trees and bushes can be arown on stony ground if only the methods could be found to utilize the nutrition they produce.

We thus need more insight in ecology and a new agricultural technology, but equally important is that the improved technology is developed for the conditions prevailing in the countries where the food is needed and that it is applied there. This means that the development of methods for cultivating the often very sensitive tropical soils without degrading and eroding them is crucial for accomodating growing populations in Middle Africa, parts of Latin America and South Asia. Ways of irrigating, without causing water-logging and salination are important in India and other Asian countries. Methods of utilizing high altitude areas and mountainious land are important in China, East Africa and parts of Latin America. Improved methods of storage would give rapid and substantive results in many countries. In Europe, Northern America, Temperate Latin America and few other places it should be possible to feed a lot more people without causing the environmental problems of today by simply using more labour-intensive methods and increasing somewhat the vegetarian component of the food. The obstacles are, of course, economic.

With methods like these a 2- or 3-fold increase in food production is, maybe, attainable, but it would require an incredible effort, the main part of which has to be made by the poorest mations.

The increase of the food production attainable in the near future will, however, in first hand be required for feeding the additional people. Under favourable conditions, including political conditions that are stable and conducive to the application of new techniques, a more rapid increase of the food production can surely be reached with the above discussed methods. Anyway, the unsatisfactory food supply, which a large part of the population in the LDCs now live with, will be the prevailing state of affairs for many years to come. Under optimistic assumptions i.e. that all uncertain conditions will evolve in a healthy direction - the development could possibly turn for the better during the next years. With less optimistic assumptions the food situation will continue being imfavourable and the issue of population and population growth will retain its actuality.

D. Reproductive research

Existing knowledge of reproduction is grossly inadequate and calls for a greatly intensified research effort in e.g. the behavioural, economic, pharmacological and epidemiological disciplines. Much more knowledge is needed of factors influencing behavious and motivation. No doubt, a fertility decline is possible with the present means, but could be achieved more readily and with less suffering on the part of the women, if a variety of new fertility regulating agents and methods were developed.

WHO recently initiated an expanded programme of research, development and research training in human reproduction. The overall objective of the programme is to increase the understanding of the human reproductive processes leading to the development of a variety of safe, acceptable and effective methods for the regulation of human reproduction. The programme has developed along two lines, one involving research on the biomedical aspects of reproduction (including reproductive endocrinology, physiology, pharmacology, and clinical problems); the other concerned with epidemiological and administrative research with special emphasis on the delivery of health services in the field of reproductive health and disease, including family planning.

The programme is strictly goal oriented, aiming at developing new fertility regulating agents;

collaborative, taking advantage of WHO's ability to obtain the cooperation of scientists in all parts of the world;

directed, with priorities defined by the Advisory Group; whenever feasible and ethical, priority is given to applied studies in humans;

complementary, being designed to complement, rather than substitute, the efforts of other supporting agencies.

The first multidisciplinary research and training centre was established in 1971 in Stockholm, at the Karolinska Institutet. Negociations are under way for four major multidisciplinary research centres in different regions; it is expected that they will be functioning before the end of 1972. In addition, a worldwide network of clinical research centres will be established; so far some 15-20 centres in as many countries have been designated.

Leading scientists from industry attended a meeting at the WHO Headquarters. A number of companies approached WHO with compounds and agents to be tested clinically. Contractual arrangements have been completed with several companies, such arrangements enabling

WHO to provide national family planning programmes in developing countries with the drug at a cost basis. (For further information on the WHO research programme, see Appendix II, a report by Egon Diczfalusy, of the Karolinska Institutet, Stockholm).

In spite of the WHO programme and other research efforts, the general outlook is a gloomy one. In his paper, presented at the Pugwash conference in Sochi, Carl Djerassi reviewed a number of problems in the field of human reproduction and contraceptive research. He gave an excellent review of the reasons for the disenchantment of the pharmaceutical industry to devote its resources to the development of new fertility regulating agents. In addition, there are other factors which cause deep concern. Egon Diczfalusy has summarized these as follows.

1. Inadequacy of funds. A tremendous amount of lip service has been rendered to the case, but the fact remains that funding of research in the field of reproductive research is grossly inadequate. The majority of national Research Councils (even those represented at the WHO meeting) have not increased their own funding in this field. Furthermore, 70 % of the applications approved by the National Institute of Health in the United States cannot be funded. Moreover, the Ford Foundation, which provided a most important support (some 100 million dollar) during the decade 1960-70, has recently diminished its contributions and it is not unlikely that the Ford Foundation will discontinue support of this field within the next 5-6 years. The rationale of the Ford Foundation is that the field requires much greater funds which can only be made available by governments and international organisations, such as the UNFPA. The Ford Foundation feels that their role was to call the attention of governments and international organisations to the existence of the population problem and they feel that they have achieved this by their large scale programme during the 60-ies.

2. Lack of coordination. The various agencies supporting research in this field have no established mechanisms for coordinating their activities. As a consequence of this, they often "compete" for the favours of the few outstanding research workers in the field. It is also clear that it is very difficult for certain national agencies to dissociate completely the objectives of their programme in supporting the field from general political objectives. Many examples could be quoted in support of the above statements.

E. Statements on population and family planning: national or regional

To illustrate the great variety in the population problems as seen in different parts of the world with different political systems, we have here selected a few examples representing Africa, Asia and North America.

Africa

Population conferences to plan potential action have been held in Latin America and Asia. Most recently in Africa in December 1971, in Accra, on the theme "Population in African Development". The conference was sponsored by the United Nations Economic Commission for Africa (ECA) and the International Scientific Study of Population (with the co-operation of the International Planned Parenthood Federation).

"Two main themes emerged from the discussions. The first was on the important role that demographers should play in policy-making and economic planning. In this connexion, however, it was agreed that techniques and concepts which have been borrowed from the West need to be adapted to African realitites. The second major theme of the conference was that population change had to be integrated into the comprehensive framework of economic and social development. It was repeatedly stressed that family planning, which was one aspect of a national population policy, should be viewed in terms of the health and welfare of the individual and the family, especially the mother and the child. It was recognized that the main thrust of any population policy should be the improvement of the quality of life of present and of succeding generations." (Newsletter on the Status of Women. May 1972, No.43).

Nigeria

Dr J B Akingba, gynecologist at the University Hospital, Lagos: In this pamphlet it has been clearly shown that this world-wide problem of unwanted pregnancies is the cause of untold hardship and even of deaths among Nigerian females at the present time. Nigerians have both privately (e.g. by questionary and in ordinary conversation) and publicly at seminars and through the press expressed a desire for change. (The problem of unwanted pregnancies in Nigeria today, 1971).

People's Republic of China

Statement by the Chinese delegate to the 52nd session of Ecosoc, May 19, 1972:

"With regard to the population question, according to our experience, it is in the interest of the people

for a country to adopt a policy of planned growth of population taking into consideration of its long-term development and the people's health. In our view, as the conditions vary from country to country, it is up to the governments of different countries to adopt policies and take measures in accordance with their own specific conditions, and no forcible uniformity should be sought. - - -

After the founding of the People's Republic of China, it is only natural that there has been an increase of population in China as compared with old China as a result of the fundamental change in economic and social conditions. China has a big population which has now exceeded seven hundred million. - - - The living standard of the people is rising gradually.

For the protection of woman and children and good education and care for the next generation in the interest of the health and prosperity of the nation, the Chinese Government has all along actively called for family planning. With the exception of sparely populated regions of national minority, extensive propaganda for late marriage and birth control is being conducted in the urban and rural areas. Free supply of contraceptives to the people in China has been administered. Owing to the adoption of effective measures in various fields, the natural rate of population growth stands about 2 % annually.

U.S.A.

Letter to the President and Congress, by the Chairman of the Commission on Population Growth and the American Future, John D Rockefeller, introducing the report (Population and the American Future, 1972):

"After two years of concentrated effort, we have concluded that, in the long run, no substantial benefits will result frm further growth of the Nation's population, rather that the gradual stabilization of our population would contribute significantly to the Nation's ability to solve its problems. We have looked for, and have not found, any convincing aconomic argument for continued population growth."

F. The situation of families and individuals, women in particular

It is estimated that more than two billion men and women do not have access the methods of reproduction control offered by modern science. Many countries have not included family planning in their health services or social welfare programs. The lack of training for physicians and medical health workers in modern contraceptive techniques is apparent, and constitutes as serious obstacle to a successful attack

on the population problem. The majority of mankind have no access to education about the functions of human reproduction. The need for such education is particularly urgent in countries in which a major part of the population (in many instances up to 40 %) are under fifteen years of age. Such education is shown to have not only personal value, but also to put pressure on the local and national authorities to improve the family planning services.

Regardless of the risks involved, abortion is the only effective method of family planning available to vast numbers of women. According to an estimate of 1967, there were at least thirty million abortions each year in the world, out of which only 1/6 were legal. It is estimated that nearly half of the world's population live in countries - developed and less developed alike - in which abortions are not legal or allowed only on strict medical grounds. This means that most abortions are performed clandestinely with crude and primitive techniques, causing maternal deaths and life-long ill health. The majority of women who undergo such abortions are married housewives unable to cope with larger families.

In such a situation, it is important that the harmful effects of abortions should be reduced as far as possible. Hence, it is to be desired that criminal laws governing abortions should be repealed in all countries and that termination of pregnancy should have the same status as any other medical procedure.

It should further be remembered that malnutrition is estimated to affect 2/3 of the world's children, causing premature death or lasting mental or physical illness. The following points, all related to the quality of life of the individual, should also be considered:

the medical consequences for the mother of a great number of births and abortions. (NB the risk, in case of abortion, of miscarriage and premature births in the future, or of sterility);

the lack of adequate care and education in families with too many children;

the economic and psycho-social disadvantage for mother and child when the child is not desired.

The woman's position within the family and within society - often referred to as "the status of women" - is related to family planning in many complex ways. Family laws and traditions, as well as her educational level, affect not only her status in general, but also her fertility. She may not be given access to information regarding human reproduction and the function of her own body. In such case, the human right to space

children is illusory as far as she is concerned. If women are regarded to have their full value as mothers only, or potential mothers, an attitude will be created in them, as well as in their husbands, which tends to be negative to family planning. If, on the other hand, women are expected to take part in public life, their attitude and motivation, and that of men, will probably be more in favour of family planning. - The lack of success often found in family planning programs may be connected with factors indicated here or similar to these. (Cf the report of the UN Commission on the Status of Women, December 28 1971, "The Role of Women in the Family: Status of Women and Family Planning").

To sum up: The situation as outlined here stands in disconcerting contrast to the principles adopted by the UN, as quoted in par.I. For the majority of mankind the knowledge and means provided by medical science for controlling human reproduction does not yet exist.

G. Family planning and population planning

In any discussion of population issues, a distinction should be made between family planning and population planning. The former concept refers to the welfare of the individual and the family; the latter concept refers to the population of a nation (a region, or the world), considering the resources of the nation (region etc), its social structure, and population pyramid, and so forth.

A number of reasons for family planning can be summed up thus:

the mother's health,
the child's health,
the suffering of mother and child in case of an unwanted pregnancy,
the standard of the family with few children as compared to a large number of children,
the advantage of contraceptive techniques over abortion, respectively of legal, and thus qualified, abortion over illegal abortion,
the possibilities for the women to work outside the family,
finally, the human right to space one's children and plan one's family.

The Chinese delegate at Ecosoc cited several of these reasons for the family planning policy in his country. So does the Nigerian gynecologist in his pamphlet.

Family planning, if practised on a large scale as in China, has a great effect on the population of the nation. However, a family planning policy does not necessarily aim at limiting the population of the country. The Chinese delegate noted as "natural" that the population of his nation had grown since the revolution, although he implied that the rate of growth has gone down. Statements from the Soviet Union indicate a wish on the part of the authorities to have an active family welfare program, including family planning, and at the same time population growth! Logically, it is possible to combine a family planning program with a policy aiming at a population which is diminishing, stable or growing (at various rates).

In the West, the concept of population planning, is often used to denote a policy aiming at "reducing population growth by lowering birth rates" (Rapid Population Growth, p.81). In other parts of the world, however, such an interpretation is not taken for granted. The unwillingness to accept the "western" idea of population planning is sometimes quite strong. Three reasons may be noted:

1) In many LDCs population planning in the western sense is resented precisely because it is regarded as an invention of western industrialized countries. Since the origin of an idea cannot prove or disprove its value, the argument is not very rational, but it seems to be emotionally effective.

2) It is felt that the nation (or an Ethnic group within a nation) needs more people to become stronger. Hence a population policy does not aim at reducing the rate of growth, or only to a limited extent. Striking examples of this position are found in Africa, South America and - within a single nation - some minority groups in the United States. (See Rapid Population Growth, chapter XIV).

3) It is assumed that population figures will "correct themselves", provided the socio-economic structure is changed for the better. Raise the people's standard of living, give education for the children and opportunities for the women to work outside the home - then the size of the families will go down. Other measures are not required. We are convinced that such methods are needed, but is should be stated, and repeated, that population planning programs and socio-economic policies have to be combined.

The relationship between family planning and population planning is an intricate one. Still more so, since governments may prefer to speak in terms of the former although they also strive to affect the latter. A successfull family planning policy may lead to a slowing down in the rate of population growth, and the two policies might be said to coincide in some instances.

Obviously, a family planning policy has a more immediate appeal ("Look at these worn-out mothers, at these children who don't get sufficient care!") than a population planning policy. Precisely for this reason, it is extremely important to realize that family planning programs are fundamentally insufficient. There may well be a conflict between the welfare of individual families and the need to respect the nation's resources. These resources - economic and ecological - must be estimated not only for the present and the immediate future, but several generations ahead. A population growth which may be thought to increase the nation's strength up to the end of this century, may prove harmful after still another generation or two. The same thing is true about the exploitation of the natural resources.

Ultimately, the population question transcends the interests and resources of separate nations. It concerns the resources of the world. This argument is in fact the most powerful of all, and in it self sufficient, but it has the drawback of being the most abstract. The urgent task is to make governments as well as citizens see the strength, the inevitability of an argument which has little immediate appeal. Also, to realize the fact, determined by nature, that different nations have a common concern here, regardless of the distrust between them (e.g. between u-countries and i-countries). For their population policies, national leaders and governments need to expand their estimates in two dimensions: in time, up to at least the middle of the next century; in space, to include the total ecological system of the globe.

World organisations have little or no executive power, and, besides, do not always function too well. For results on a large scale one has to aim at the national or regional level, i.e. in most cases the governments. It is of paramount importance to deliver infallible evidential material to convince them.

H. Conclusions

With the exception of a few countries, voluntary methods of family planning and education on human procreation have not been tried on a large scale. Those stating that family planning programmes on a voluntary basis are doomed to fail, should be reminded hereof. It is urgent that ways are found to reduce the population growth in both developing and industrialized countries. The national Pugwash groups have a double duty in this respect. As organizations of scientists they should launch studies of all aspects of population problems utilizing all scientific knowledge by a multidisciplinary approach. Thus they

should find new openings to research which can lead to solutions of the national, regional or global population problem.

The Pugwash groups should also use their scientific competence and their political independence to convince their respective government of the need for a population policy which includes the decision to arrive at an optimum population for the country and policies to attain this goal. It is the responsibility of governments to make all family planning measures available for their citizens (from intra-uterine devices, the pill and male contraceptives to sterilization and abortion), as well as to provide education in the whole area of human reproduction.

We strongly recommend each national Pugwash group to organize a study group on population and report its results at coming General Conferences.

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STATEMENT FROM THE CONTINUING COMMITTEE ON THE 22ND PUGWASH CONFERENCE, HELD IN OXFORD, SEPTEMBER 7-12, 1972

The twenty-second Pugwash Conference on Science and World Affairs, organized by the British Pugwash Group, was held in Oxford from the 7th to 12th September 1972. It was attended by 210 scientists, observers, and students from 44 countries and 6 international organizations. By Pugwash standards this was one of the largest conferences; the high attendance was due to the additional task of the meeting: to discuss and adopt a programme of Pugwash activities for the next 5 years, as well as the organizational procedure for the election of the governing body of Pugwash.

The Conference first considered whether, after 15 years of existence, and the considerable change in the world situation, there was still a raison d'être for Pugwash. It came up with the unanimous answer that there is a continuing rôle for Pugwash at least as important as it has had hitherto. Pugwash is unique amongst international scientific organizations. It offers an opportunity for scientists of many disciplines and men of affairs from all over the world to meet regularly for free, informal and private exchange of ideas concerning vital problems of world affairs, to which scientific study and analysis may properly be expected to contribute constructively. The Conference reaffirmed that the ultimate goal of Pugwash is the establishment of a lasting world peace, based on the mutual respect of all nations and peoples, and on the principles of individual and collective justice.

It was agreed that Pugwash activities would be three-fold: (a) aiming at influencing governments; (b) to pinpoint, within the scientific community, the consequences, good or bad, of new scientific discoveries and their technological applications; and (c) to inform the general public about the contributions made by scientists towards the solution of problems of basic political, economic and social importance, especially those bearing upon world peace and security.

It was confirmed that the main preoccupation of Pugwash should continue to be the problems of disarmament and related issues of international security. However, it was agreed that high priority should also be given to other problems, particularly those which form a link between peace, disarmament and development. The selection of topics for discussion in Pugwash should be based on the following criteria: they are not being dealt with through conventional channels; they are susceptible to scientific analysis; they are timely, in the sense that the recommendations from Pugwash Conferences can be expected to have an influence on the course of events.

Within the above framework of future activities, the Conference drew up guidelines for the structural organization to carry out these activities, and procedures for the election of its governing body, the Continuing Committee. The present Continuing Committee was

empowered to supervise the election of a new committee in accordance with these guidelines.

In plenary sessions the Conference also discussed new initiatives towards disarmament and the current situation in Vietnam. Based on these discussions the Continuing Committee drew up a statement on Vietnam, which is appended.

Most of the work of the Conference was carried out in eight Working Groups. Each of these Groups culminated its work with an agreed report. The following statement is based on the reports from the Working Groups.

1. Disarmament Programme for the Near Future

Strategic Arms Limitation

Millions of people had looked forward with hope to the agreements to be reached by the United States and the Soviet Union to limit strategic arms. While the agreements reached at the Strategic Arms Limitation Talks (SALT) would seem to fulfil their hopes to some extent, a measure of their true significance is not yet possible. It will become so only as new weapons development and acquisition decisions of the Soviet Union and the United States unfold; and as the next stage of SALT develops. From the present perspective, the view of the results of the first stage of SALT must be mixed.

The ABM (anti-ballistic missile) treaty is important in that it should allay concerns that either the Soviet Union or the United States will deploy ABM defences which could induce the other to increase its offensive force capabilities. It also indicates that it is possible to reach agreement on verification procedures that will permit the negotiation of treaties which impose important constraints on strategic arms. In addition, the ABM Treaty, and the agreement relating to offensive forces, are important in that they signify an improvement in the political climate, that may make possible more far-reaching arms control and disarmament measures.

Turning to the future, it is our hope that, consistent with the obligations they have undertaken, both the Soviet Union and the United States will approach negotiations with a sense of urgency and a determination to conclude agreements to limit a broader range of strategic arms than those covered by the first SALT agreements, to reduce levels substantially, and to slow the introduction of new and improved weaponry. In the meantime, both should exercise great restraint with respect to the initiation of new strategic weapons programmes and the continuation of these that are now under way.

If future negotiations should be used as an excuse or argument for new or expanded strategic arms programmes, so as to be able to negotiate from a position of strength, we question whether such negotiations would be worthwhile. An effort to accumulate such "bargaining chips" for use during negotiations could result in a growth in strategic weapons so great as to offset any advantages that might result from eventual agreements.

The following specific measures were suggested as important further objectives for SALT:

a) Dismantling of existing ABM defences and a prohibition on all further ABM deployment. The levels now permitted are militarily meaningless and a waste of resources. Accordingly, such agreement should be easily achieved. Until such agreement can be reached, or failing its achievement, there should certainly be no further deployment of ABM systems.

b) Establishment of limits on offensive delivery vehicles and warheads at levels very substantially below those now existing. Among other advantages, this would be particularly important in convincing the other nations that the United States and the Soviet Union take seriously their obligation under article 6 of the Non-Proliferation Treaty.

c) Severe limits on those kinds of tests of strategic weapons systems that can be monitored by non-intrusive national means. In such limitation, is the best hope at the present time of inhibiting the introduction of new technology which is a primary factor, indeed, in the view of many, the dominant factor, in the strategic arms race.

Irrespective of agreements that might be reached, the Soviet Union and the United States should exercise great restraint in developing or introducing new weapons which could diminish the confidence that each has in the viability of its deterrent forces, and which accordingly could lead to a further escalation in arms as a result of efforts to restore confidence. Examples given of the group of areas where such restraint may be needed are: in anti-submarine warfare systems, which might cause an erosion in confidence in the presently invulnerable submarine-based deterrent forces; and in the development of greatly improved missile accuracy which, particularly if employed with multiple warheads, might increase concern about the vulnerability of land-based missiles (although not, of course, affecting the viability of other deterrent forces).

Nuclear Proliferation

There is a connection between the problems of proliferation of nuclear weapons to states not now possessing them and the growth of nuclear stockpiles in the nuclear weapons states (horizontal and vertical proliferation, respectively). Unless a denuclearized world is recognized as an ultimate goal accepted by all, the non-nuclear weapon states may not tolerate remaining indefinitely in a position that is perceived as an inferior one. The viability of a world situation based upon the distinction between nuclear-weapon and non-nuclear weapon states is likely to become even more precarious as the technological barriers against the acquisition of a military nuclear capability become more easily surmountable.

In some cases, interest in the development of nuclear explosive devices for peaceful purposes is used as a justification for a nuclear test programme. The claim of great

utility of peaceful explosions appears to have little foundation, at least as regards the foreseeable future, so that it is difficult to view it otherwise than as an excuse for acquiring a nuclear weapons capability.

The enormous world-wide spread of nuclear fissile material (mainly plutonium), and of nuclear know-how, which is going to occur in the next one or two decades to satisfy the energy demands of the world, constitutes a problem of staggering proportions. It is clear that the management of this problem will necessitate a high degree of international collaboration, if disasters of major proportions are to be avoided. It is difficult to imagine that such an amount of collaboration will be possible unless detente and disarmament make substantial progress in the immediate future.

There is a danger, to some degree already present, that processed fissile materials in storage or in transit may fall into the hands of irresponsible, possibly criminal or fanatical groups. The need for ensuring the physical protection of fissile materials, by both international and national means, must be strongly emphasized.

Comprehensive Nuclear Test Ban Treaty

The fact that the test ban treaty has not restrained nuclear testing underground is deplorable.

A comprehensive treaty should be easily achievable now, since it is widely recognized that the problem of verification is no longer a serious or legitimate argument against agreement. The risks, implicit in testing that could not be detected and identified as such by unilateral, non-intrusive techniques, would be more than offset by the advantages of such an agreement. This is particularly so now that the military utility of further tests has been diminished as a result of the ABM treaty.

No Use of Nuclear Weapons against Non-Nuclear Countries

The viability and universality of the Non-Proliferation Treaty would be considerably strengthened by a pledge, issued by the nuclear countries, barring the use of nuclear weapons against countries which do not permit weapons of mass destruction on their territory.

Limiting Military Research and Development (R and D)

The importance of limiting military research and development was emphasized, since it is such activity that fuels the arms race. The difficulty of limiting it was also noted.

Severe limitations of R and D could be expected only at an advanced stage of the disarmament process, and not at the beginning. Nevertheless, there is need at least to slow down military R and D, and there are some possible means - ethical, political, organizational, and other - to achieve this end. It is recognized that it is not easy to envisage agreements to limit military R and D, that would not require intrusive verification. A way out of this difficulty is to concentrate on the development and testing stage. Other possibilities focus

on R and D budget reductions. A scheme for verifying reduction in military R and D, by observing the flow of personnel from classified to unclassified research work, was also outlined and discussed.

Limitation of Military Budgets

Even only a freezing of military budgets would mean diminishing force levels, because of increasing costs of modern weapons. Such proposals are attractive in that they would permit to each party flexibility of choice about the structure of its forces, and accordingly, in some respects, negotiations could be relatively simple.

Recommendations were made that there should be limitations on budgets, and that intergovernmental efforts be undertaken to develop the requirements for disclosure and auditing procedures which would be adequate to permit verification of agreements involving substantial reductions.

Biological and Chemical Weapons

We note with satisfaction the opening for signature of the convention prohibiting biological weapons. We also note the completion of destruction by the USA of its stockpile of biological weapons (BW) in conformity with the United States unilateral declaration and the 1972 BW Convention. We call upon all other nations which have not undertaken to destroy their stockpiles to do so.

We also note with regret the failure to obtain ratification by the United States of the 1925 Geneva Protocol and urge that ratification be accomplished without delay, including interpretation of the Protocol as covering tear gases and herbicides.

We deplore the lack of progress in the CCD (Conference of the Committee on Disarmament) during the past year with respect to the creation of a treaty to control chemical weapons (CW), as stipulated in the 1972 BW accord. The central problem continues to be that of verification. The continuing lack of agreement on CW poses great dangers, because of the existing large stocks of CW agents, the relative ease of their production by many countries, and the possibility of their use in local conflicts.

In connection with verification of a CW treaty, attention should be given to the precedent set by the SALT agreements.

Incendiary Weapons

Incendiary weapons, especially napalm, although specifically excluded from the Geneva Protocol of 1925, are now very widely regarded as inhumane, even in comparison with explosive weapons. We condemn utterly the employment of weapons, and especially incendiary weapons, under conditions of conflict that may possibly involve civilian population.

We call attention to the report on incendiary weapons to be submitted to the United Nations General Assembly this autumn, and to the forthcoming SIPRI study of napalm and incendiary

weapons, and express the hope that these reports will be instrumental in outlawing this class of weapons.

Geophysical Warfare

There have been considerable advances in the geophysical science and technology of weather modification. It is clear that this area of science could develop to the point where it has substantial military applications. Accordingly, we recommend that an international treaty be concluded which bans the use of weather modification in wartime. Some consideration should also be given to broadening such a treaty to prohibit other types of geophysical warfare.

General and Complete Disarmament (GCD)

While there are differences on the feasibility of general and complete disarmament, and the attention that should be given it relative to other measures, there is unanimity that it must be the ultimate goal of arms control and disarmament efforts.

Since the subject was last discussed in intergovernmental meetings almost a decade ago, the political situation has improved, particularly between the NATO and Warsaw Pact powers. Also, with national verification capabilities having been greatly improved and with the acceptance in SALT of their legitimacy, and the agreement that they ought not to be interfered with, verification of compliance of GCD should be less of a stumbling block to agreement.

Despite the fact that there remain serious impediments to the attainment of GCD, particularly the continuing lack of agreement on peace-keeping machinery, the changes since the early 60's are sufficient to justify renewed and serious efforts to develop phased programmes for GCD. This is important, because the present situation would permit a substantial movements towards GCD, and with such movement, there could well be progress on peace keeping as well.

2. Disarmament in Europe

The Group discussed the short-term aspects of disarmament in Europe; there is need for deeper study of more radical long-term solutions.

Reductions in forces and armaments on a straight percentage basis do not necessarily give greater security. There is a danger that excessive concern with the concept of balanced reductions, and with quantitative disarmament schemes and their verification, might lead to greater mistrust rather than greater security.

One of the major risks involved in the present military situation in Europe arises from the Western doctrine of early response with so-called tactical nuclear weapons. For any prospect of disarmament it is essential to create such military and political conditions that this doctrine no longer appears necessary. There was no agreement whether there is in fact a rough equilibrium of conventional forces between the two alliances in Europe, or whether the West has a substantial inferiority

in conventional forces which needs to be bridged by a strategy involving the early use of nuclear weapons. We fear that the development of a new generation of very small tactical nuclear weapons might make a resort to nuclear war more likely. This is an additional strong argument for a comprehensive test ban.

The setting up of a limited nuclear-free zone on both sides of the boundary between NATO and Warsaw Pact territory would reduce the likelihood of a nuclear confrontation, and contribute to a further easing of tension between East and West, which is a precondition of progress towards disarmament.

Another threat to European peace is the current naval arms race in the North Atlantic and in the Mediterranean. An agreement on a phased reduction of naval forces might be part of an agreement including also the tactical nuclear and conventional arms of the USA and the USSR, perhaps in the context of an agreement between NATO and the Warsaw Pact group.

3. European Security and Co-operation

The Group concerned itself with mechanisms for European security and European co-operation. It welcomed the forthcoming European Security Conference, which will take place in a political climate that had recently shown a marked improvement. The importance of ensuring that states of Europe participated in the conference on an equal footing was emphasized. The most effective organization of the Conference would be a relatively short high-level meeting leading to the setting-up of specialized working groups.

Europe has a great interest in measures which increase its security from nuclear war, because of its great vulnerability in such a war, but security is not purely a military matter - it is also a state of mind. A successful outcome of the European Security Conference not only depends on a satisfactory security framework in the world at large, but may also contribute to it. It is vital that no nation should appear to have territorial ambitions and that all states of Europe should establish normal relations.

It is hoped that both German states would shortly join the United Nations, and that an early outcome of the Conference would be a re-affirmation by all parties of their acceptance of the basic principles of the UN Declaration on friendly relations among states, of the existing political boundaries, and of the differing social and economic systems.

However, such a reaffirmation must be accompanied by specific measures which can produce a more tangible sense of European co-operation. These include co-operative ventures, such as the car manufacturing projects of Italy and Poland and the gas pipeline from the USSR to the FGR. Such projects create a vested interest in peace which is stronger than treaties. It is worth studying ways of fostering a more rapid growth of such projects. Constructive co-operation is also essential on environment problems, such as the pollution of European rivers and the

Baltic. Such joint projects can contribute to overcoming mistrust between nations, and this can also be assisted by joint scientific societies (following the example of the European Physical Society) and other joint cultural and social undertakings. Ideas along these lines include the hope of a European television system, joint textbooks and materials for school teaching, and greatly increased collaboration in medicine and public health.

There are still barriers to co-operation which are relics of the cold war. Many of such barriers could be removed without risk to the social or economic system of the countries involved.

Care should be taken to ensure that regional "European" institutions should not be developed in a manner which impedes co-operation and collaboration in the whole of Europe.

4. Security of Developing Nations

Security broadly means a nation's capacity to attend to the problems of its development, without hindrance created by the use, or the threat of use, of force against it by others. In less developed countries, problems of security involve political self-determination and economic emancipation. Strategically speaking, the awareness of these factors shows itself in the mobilization of large armies and build-up of armaments. The security of developing nations appears to be directly related to the global international situation.

The conduct of developed countries pursuing their interests, strategic and economic, in less developed countries, is obviously hard to change. But only under conditions of mutual respect, and agreement between developed and developing countries, can development proceed in desirable directions. The expense of buying arms could be then channelled into programmes for socio-economic development. A code of conduct in the sale of arms by arms producers is needed. Such arms sales must be open to international scrutiny.

Developed countries should not, for their own strategic reasons or for commercial profit, pursue the build-up of armies, navies, and air forces in developing countries, nor should they establish foreign bases there.

Problems of national security appear to be different in some respects in countries of Asia, Africa or Latin America. The situation in the Middle East was extensively discussed, and although no specific agreement was reached, the consensus was that the Security Council Resolution No. 242 of 22nd November 1967 should be implemented as soon as possible. Some members supported the UN Resolution 2799 of 13th December 1971 calling upon Israel to respond favourably to the UN Special Representative's peace initiative of 8th February 1971.

In Africa, where tribal disputes exist in some countries, the role of the armed force appears in some cases to be related to the domination of certain tribes by others.

Policies of racialism and colonialism in Southern Africa pose a serious threat, and the governments of South Africa, Portugal and Rhodesia should not be allowed to add to their military potential by arms deliveries from developed countries. Attention was called to the fact that South Africa has not signed the Non-Proliferation Treaty and is reportedly producing enriched uranium. It was urged that Pugwash should study the prospects and implications of possible development of nuclear weapons by South Africa.

It was noted that there are now new hopes of international accord and peace in certain conflict-ridden regions of the Asian continent. The two Koreas, as well as India, Pakistan and Bangladesh, are carrying on direct negotiations to resolve their outstanding problems and to create normal relations between them. The process of peaceful resolution of problems through bilateral negotiations should not be hindered by any overt or covert interference of external powers.

Some Latin American countries have attainted in the last years a higher level of self-determination, in both national and international policies; examples of Chile and Peru were cited in this respect. However, their economic emancipation is still delayed. Furthermore, there are continuing threats to the security of other Latin American countries arising from activities of industrial monopolies owned and controlled by external interests.

Regional economic co-operation among the developing countries is of essence, and highly advisable. The intensification of this co-operation and, perhaps, the setting up of some new regional organizations with specific tasks, preferably within the UN, is desirable.

It was agreed that - in spite of the lack of effectiveness of the United Nations in achieving all its purposes - this organization remains one of the best channels to settle differences between countries; and that the UN resolutions for peace and world security should be sustained and implemented. The consensus was that developing countries should be encouraged to make use of the fact-finding system established by the General Assembly of the United Nations in 1967 in order to contribute to the settlement of their international disputes in a peaceful manner. Experts from the regions involved should be resorted to as much as possible to attenuate the feeling of being patronized. The importance of UN agencies, as possible channels of international aid to the lesser developed countries, was stressed.

5. Problems of Developing Nations

The extremes of unequal distribution of wealth among nations constitute one of the greatest threats to world security. In this connection we believe that development of the now "less developed" countries (LDC's) means not only of reduction in economic disparity between them and the "more developed" countries (MDC's), but also acquisition of autonomy, now often impaired by the activities of foreign corporations, as well as by foreign aid as it now tends to operate.

We believe that scientists from

socialist countries, as well as those from countries whose economic system is based on private or mixed enterprise, can agree that it is in the interest of all mankind that LDC's acquire the scientific and technological capacity needed for them to implement whatever decisions those countries may take concerning their future development. The example of countries which have undergone rapid development in the framework of different social systems shows that they have done so largely on the basis of a broad spread of education and research capacity, enabling them to utilize the already abundantly relevant knowledge, to adapt it to local conditions, and to create new knowledge, applicable to their economic progress.

The Group discussed barriers to development originating in unfavourable socio-political conditions, such as:

a) lack of understanding, by the political leadership of many LDC's, of the importance of making full use of their existing resources of scientific and technological competence, and the need to foster broader education and training of local scientific and technological cadres;

b) policy of many foreign enterprises of importing technology and research capacity, rather than contributing to the technological advancement of the LDC in which they operate;

c) the pursuit by some MDC's of policies which fail to foster, and in some cases even slow down, technical and economic progress in the recipient country;

d) lack of communication channels among scientists and development specialists in the LDC's which can lead to wasteful duplication of efforts, and a sense of isolation;

e) large LDC expenditures for armaments, reducing resources available for development purposes.

Pugwash could assist in the development of attitudes in LDC's and MDC's alike, that would accelerate the elimination of these constraints. It could exert its influence to ensure better utilization of existing knowledge. It could contribute substantially to the initiation and development of new programmes fostering scientific and technological research in the LDC's related to their development needs (of the type of the International Centre of Insect Physiology and Ecology, and the International Science Foundation - two programmes that had their origin in previous Pugwash meetings).

It was noted that most UN agencies dealing with LDC problems were set up in the 40's and 50's; many new problems have since been identified, and it is by no means certain that the existing structure and functions of these bodies are adequate to meet them. Furthermore, there is now such a proliferation of agencies that their operations often lead to confusion, as well as duplication. No government may be able to question the existing set-up, but Pugwash, with its international reputation for thoughtful approaches to technical problems, perhaps could do so.

It was recommended that greater

emphasis should be placed in Pugwash on problems of development, and vigorous action taken on such tasks as:

a) critical analyses of the new UN World Plan of Action for the application of science and technology for development;

b) study of the main economic and socio-political barriers to development, and the potential role of science and technology in overcoming these;

c) steps to encourage scientific bodies and individual natural and social scientists and technologists of all countries to devote more efforts to solving the problems of development.

6. International Aspects of Environmental Problems

The holding of the Stockholm Conference on the Human Environment, and the continuing activity that will result thereupon, have led us to focus our attention mainly on those problems where Pugwash is especially equipped to make a unique contribution.

Interim International Standards of Environmental Degradation

Pugwash must warn governments and peoples that the task of halting and reversing environmental degradation is urgent. The Stockholm recommendations require much research to gather data on which to fix international standards. Until the research is complete, interim standards should be adopted.

An International Energy Institute

Research and analysis of the energy problem in all its aspects is urgent. In view of its global character - and also because of the involvement of socio-political and environmental problems, as well as the necessity to find a uniform solution to the danger of diversion of fissionable material for clandestine production of weapons - such work would be best served by an international institute.

Disposal of Nuclear Waste

Pollution may result from large-scale power production by nuclear fission. In normal operation pollution from the power stations themselves is easily reduced to a very low level, and most of the possible pollution results from the disposal of nuclear waste extracted or evolved as gas in the reprocessing of fuel elements. The standards applied to direct dumping into the sea of diluted radioactive waste should be revised, keeping in view the possible accumulation of long-lived radionuclides.

The present method of storing most of the radioactive residue resulting from the reprocessing of fuel elements, as concentrated highly active solutions in underground tanks, though quite safe in normal conditions, is not satisfactory, because of the possibility of the destruction of the tanks either though an accident or bombing in a conventional war. Other methods of long-term storage must be identified, tested and adopted as soon as possible, even if they are significantly more expensive.

The possible consequences of a

major accident in a nuclear power station, specially in the case of a fast breeder fuelled with large quantities of plutonium, should be objectively studied by the IAEA or the proposed International Energy Institute.

Environmental Damage Associated with Military Activities

The continuation of aerial nuclear explosions is unanimously considered as unacceptable, and it is hoped that all countries which have not signed the Moscow Partial Test Ban Treaty will do so in the near future.

The occurrence and risks of environmental contamination from underground explosions, while small in comparison with aerial explosions, nevertheless adds to the reasons for extending the Treaty to include underground tests. We also call attention to the gross disturbance of the environment by war and preparations for war; obvious examples are the effects of bombardments and the destruction of forests by chemical defoliants in local wars.

Regional Conferences on Environmental Problems

With respect to environmental problems for which Pugwash might exploit its special position within a political context, the problem of the Baltic Sea provides a very good example. The Baltic is considered to be a dying sea partly because of the high level of pollution arising from the influx of industrial wastes from the industrialized countries bordering it. A systematic, sustained and co-operative effort between all the countries concerned would contribute appreciably to a lessening of frictions between them arising from pollution.

It is recommended that in connection with preparations for the European Security Conference, the following topics be considered:

- criteria for the prohibition or limitation of the discharge of specific pollutants;
- limitation or prohibition of the discharge of waste products on the basis of intergovernmental agreements;
- control and registration of discharged products on a national basis and the possibility of exchanges of information;
- control of the extent of environmental pollution in territorial waters and in open waters;
- development of optimum environmental preservation models and the forecasting of environmental changes;
- identification of research problems for co-operative action, and control methods and facilities.

Analogous considerations pertain to the River Danube and the set of problems there involved could profitably be approached in the same way.

7. World Resources and Population Problems

In recent decades a multiplicity of developments has resulted in the participation of the nations of the world into two quite separate and distinct groups: the developed and

the developing. The group of developed nations which embraces nearly one-third of the world's population, is generally characterized by high levels of personal income and consumption, and by low and declining rates of population growth. The group of developing nations, which embraces nearly two-thirds of the world population, is characterized by low levels of personal income and consumption, and by high rates of population growth. For the most part, the people of the developed countries are well-fed, healthy, well-housed and have access to education. By contrast, a large proportion of the people in the developing countries suffer from malnutrition, ill-health, lack of adequate housing and low levels of education.

Our present knowledge indicates that improved technology can provide resources which could enable all people in the world to live comfortably. Indeed, from a purely technological point of view poverty is inexcusable. Yet, unfortunately, the condition of the people in the developing countries is improving with alarming slowness. We believe that humanity is now facing an extremely dangerous situation, which may become worse with each passing year, unless vigorous action is taken. Every effort should be made to accelerate the rates of development of the developing countries and to decelerate the rate of growth of world population, recognizing the inter-relationships between the two processes.

Scientists should recognize the importance of the problems associated with rapid population growth and should make every effort to contribute to their understanding and solution through a multi-disciplinary approach. The following areas are in particular need of increased attention and particularly appropriate for consideration by all concerned scientists:

a) biology of reproduction and fertility control technology;

b) impact of modern demographic changes, such as urbanization and differential fertility on human genetics;

c) effect of continuing rapid population growth on world tensions;

d) effect of continuing population change on the environment, including pollution.

While the problems associated with population growth are, in the ultimate analysis, global ones, it is clear that they must be approached primarily at the national level. Therefore, in each country, developed and developing alike, scientists should urge:

a) the study and development of population policies that can be used to cope with the country's specific population situation;

b) the collection of accurate demographic data that can make possible an assessment of the current situation, as well as realistic projections of future trends;

c) the widespread availability of methods of contraception and birth control, so that people will be encouraged to plan their families;

d) the introduction of population and

sex education in schools, and the use of mass media for the education of the general public;

e) encourage the dissemination through scientific media of deeper knowledge concerning population problems;

f) the holding of national and regional conferences in order to discuss legal problems, policy and strategy.

Finally, we endorse the attached proposal to create a new International Centre for Population Studies which would help fill an important gap in population research.

Establishment of a Centre of Population Studies in Stockholm

Until now, social scientists who deal with population problems and natural scientists who address themselves to human reproduction and fertility control, have almost never collaborated. Furthermore, new methods of fertility control are usually developed in technologically advanced countries, and brought to the attention of the less developed countries at a much later stage, when they are often found unsuitable for social, cultural, economic, legal or political reasons. Therefore, it is proposed that an international, non-governmental research centre - on the model of SIPRI - be created in close proximity to the WHO-Karolinska Institute (Stockholm), which would make it possible for social scientists to work very closely with natural scientists on designing plans for new approaches to fertility control; these plans could then be recommended to action-oriented institutions of individual countries, or of international agencies (e.g. WHO).

An example of the type of work to be undertaken in the proposed Centre would be pilot studies of an integrated nature, in which social scientists (primarily while on leave from their home institutions), with expert knowledge of a given country or geographic area, would attempt to deduce the approaches to fertility control most acceptable to the people of that area, and who would then collaborate with biologists and other specialists in the development of the actual technology. At present there is an almost total absence of such interaction between social and natural scientists.

It is recommended that the Centre be governed by a consortium of academies and similar national scientific bodies following the now well established model of the International Centre for Insect Physiology and Ecology in Nairobi, which has already enlisted the co-operation of academies from developed and developing countries.

8. Scientists and Society

The teaching of science should make clear that much of the responsibility for the applications of science rests with the scientists themselves. We reject the notion that science and the impact of science on the world should be taught as separate subjects, and recommend a thorough integration of these two aspects of science education. In addition, there are serious shortcomings in the communication of

scientists both with society and among themselves. There is an asymmetry in the appreciation of one another's work between natural scientists on the one hand, and students of the social sciences, the humanities and the arts on the other. This contributes to a misunderstanding of the scientist by other scholars and the public at large.

The increased introduction of "scientific", automated, warfare, would be impossible without the concentrated effort of large numbers of scientists and engineers. We look with deep concern at the rapid development of such weapons and feel that discussions on the prohibition, or limitations on the use, of such weapons should urgently be taken up in the disarmament negotiations.

We encourage scientists to work actively to promote social responsibility and to defend human rights, either as individuals or as members of various groups, national and international, engaged in this work.

More extensive co-operation between natural scientists, engineers and social scientists is essential for adequate technology assessment. A fixed minimum percentage of the funds for technical projects should mandatorily be devoted to prior or simultaneous research on the social consequences of projects.

The Group held a broad discussion on the subject of various examples of mistreatment of scientists, in the Pugwash spirit of respect for the viewpoint of others. It was felt by some members that there is a need to collect information on an international scale on the alleged mistreatment of scientists and scholars, while some others felt that this matter should be left to scientists in each country.

The "brain-drain", resulting partly from personal motives related to working conditions, but often attributable to mistreatment, as well as the subservient role sometimes allotted to creative science, is destructive of the prospects held out by science for betterment of conditions in these countries.

After thoughtful deliberations on the questions of freedom of travel and emigration, during which different views were frankly expressed, we found substantial agreement on the following: we deplore the placing of obstacles to changing citizenship on the one hand, and the expulsion of people from their homelands on the other hand, these practices being in violation of fundamental provisions of the UN Declaration of Human Rights.

The deprival in some countries of large numbers of scientists of their livelihood on the grounds of supposed opposition to the government, once again brings into focus the special vulnerability of the scientific profession in this respect. The effective utilization of the potential of science in the betterment of the human condition is greatly hampered by the subservient role sometimes allotted to creative science. This is expecially harmful in developing countries.

The delicacy was recognized of the problem posed by the emigration of highly trained personnel, especially from lands having a shortage of such personnel.

Certain restrictions, if limited to a small number of years, and carried out in a reasoned and humane way, may have to be accepted as temporary measures.

Appendix

The War in Vietnam

The continuation of the Vietnam war, and especially the enormous escalation of aerial bombardments, is of great concern to the members of this Conference.

The increased destruction of civilian targets, as well as the blockade of the harbour of Haiphong, are only a part of the damage done by the bombing, which has exceeded qualitatively and quantitatively any such action in the last World War.

To this should be added the destruction of critical locations on the dikes and the resulting threat which endangers the whole dikes system, and thus the survival of hundreds of thousands of civilians. This issue prompted the Executive Committee of Pugwash to release the following statement to the Press on August 15th, 1972.

'In recent months, evidence has appeared in the Press, and been confirmed by neutral observers, that there have been a number of bombings of North Vietnamese dikes. The U.S. Government has denied any intention to damage the dikes, but has acknowledged that bombs, intended for military targets near dikes, have in some cases unintentionally fallen on the dikes themselves.

The monsoon season in North Vietnam has already started. Approximately fifteen million North Vietnamese depend for their safety and vital food supplies on the protection provided by the dikes against flooding. Unless the damage already done is repaired, and further damage to the dikes avoided, there could be vast suffering, and even very many deaths, among the North Vietnamese population. It is absolutely vital that there be no interference with the repairs now going on. We strongly urge the American President to give unequivocal orders to his military commanders, in particular to the Air Force Generals, that no action be undertaken by means of anti-personnel or other weapons that could - by intention or otherwise - interfere with the needed dike repairs.'

The "Vietnamization" of the war resulting in greatly reduced American deaths at the expense of enormously increased Vietnamese casualties may be politically more expeditious, but to that extent even more condemnable. In the process of "Vietnamization" the country has become a giant laboratory for the American military, which has experimented with a variety of new techniques ranging from weather modifications to highly automated weaponry.

In the light of this continuing horror we ask the American people "How much longer will you tolerate this slaughter?".

FAMILY PLANNING IN CHINA

by Kerstin Alfvén

There are no official figures of the birth rate in China. Some conclusions may be drawn from the following local observations made during a journey in China in March 1972.

Visits were paid to the Street Committee Tung Chin in Central Peking, to the Rainbow Bridge Peoples Commune outside Shanghai, and to maternity hospitals in Peking, Shanghai and Canton. In most cases detailed information including statistics was offered about the local organisation. Also some general statements were made about the family planning in other parts of China.

The Street Committee Tung Chin in Peking

The community has 52 980 inhabitants in 14 136 households, 25 643 men and 27 337 women. 6 146 pre-school children up to age 7, 16 262 school children and students. There are 22 808 workers of which 54 % are men and 46 % women.

Average marriage age is 24-25 years for women and 27-28 years for men. Late marriage is recommended and young couples are told that postponement of marriage is better for their health and work. As extra marital sex relations are very rare only married women are registered as "fertile". Hence the fertile age normally is 25 to 45. All contraceptives are free and also abortion and sterilization. A woman with two children - and even with one child - is eligible for abortion and sterilisation. A woman gets 10 days off with her full pay at abortion, 21 days at sterilisation, and 56 days at child birth. Vasectomy is rather rare.

Family planning programs are run by the small local health centers of the Street Committee, by the factory health centers, and also by the maternity hospitals. All these organisations make intense family planning propaganda and distribute contraceptives.

The most common contraceptives are IUD and the pill. The pill is delivered monthly to the homes or at the factories. Small scale experiments are made with once-a-month injections or the once-a-month pill, but these methods still give too much side effects.

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No statistics were available for the whole Street Committee, but for a small "lane" unit it was reported that of 55 fertile women 15 were sterilised, 15 used IUD, 10 the pill, 4 condoms and the remaining 11 other methods. It was reported with satisfaction that in 1971 only one child was born in the lane.

In one of the small workshops of the Street Committee with 137 women 64 were fertile and gave birth to 4 children in 1971.

In a state run factory with 2 407 fertile women 414 were sterilised, 1 061 used the pill, 164 have IUD, 588 used condoms, and 180 used other methods. It was reported that in the whole Peking more than 80 % of the families were practising family planning. In the rural areas of the whole China 60 to 70 % accepted family planning.

Visit to Rainbow Bridge Peoples Commune 15 km west of Shanghai

26 340 inhabitants of which 14 079 are workers working in 16 production brigades and 121 production teams. Every team has its own health center which also is a center of family planning. There are 6 474 households. All children go to school from the age of 7. There are: 4 028 children in the 5 year primary schools and 4 600 children in the 4 year middle schools. In 1971 there were 425 birth corresponding to a birthrate of 16 per 1000. This was not claimed to be especially good. "There are other communes with better results but also many with less good achievements". There are 3 770 women of fertile age (14 % of the population). 1 595 women who already had at least 2 children were sterilised. There were 73 vasectomies, 469 women used IUD, 196 used pills which are delivered once a month to the homes by paramedical personel, commonly called barefoot doctors. Further there were 34 cases of once a month injection, 100 cases of condoms and diafragme. Finally 190 women are supposed to be protected by breastfeeding their babies under 6 months. An intense propaganda for family planning is made, especially by the 200 barefoot doctors. They talk to the men and women when they gather for work in the early morning. They motivate a reduction of birth by the necessity to safeguard the women labour force and increasing the standard of living by having few children. The per capita income was 202 yuan last year. "If we decrease the number of children we can increase our income next year". The walls in the meeting room are decorated by tables showing detailed vital statistics of the commune.

Visit to International Peace Hospital in SW Shanghai

In the region for which the hospital is responsible there are 260 000 inhabitants and 4 000 to 5 000 birth per year corresponding to 15 to 19 per 1000.

There are 5 000 to 6 000 abortions per year and 1 300 to 1 500 sterilizations of women, 1 000 to 2 000 IUD insertions and large scale pill distribution in the hospital and in the local centers.

The propaganda stresses that birth control means the liberation of women and better health for women and children. Here, as in other hospitals, every opportunity for family planning propaganda is used. All kinds of contraceptive devices are displayed in the family planning center. Only abortions before the 12th week are made and the vacuum aspiration method is used. The abortions are made by doctors or often by specially trained midwifes and necessarily accompanied by IUD insertion or pill prescription.

Maternity Clinic of Kwang Chou Number One Medical General Hospital in Canton

The same general impression, as in Peking and Shanghai, but statistics incomplete. At the hospital 200 deliveries and 210 abortions per month. Intense distribution of all kinds of contraceptives. The women are reported to state that they do not want more than 1 or 2 children. Motivation for family planning is primarily the health of women and children and women's work and prosperity.

General remarks

It is emphasized that birth control is voluntarily. There is a strong propaganda but it is claimed that there is no enforcement.

In Peking it was reported that medical teams had been sent out to remote mountain regions in the north where birth control was practised only by 30 % of the families. After 3 months activity the acceptance was raised to 62 %. The drive is continued by local barefoot doctors. Similar activities were reported also in Shanghai and Canton.

It was reported that the family planning activity had varied in the following way. Before Liberation 1949 both the birth rate and the death rate were very high. After 1949 the mortality decreased rapidly. The resulting population increase caused serious concern in the late 50'es and a strong campaign for family planning was started. This resulted in a decreasing natality in the middle 60'es. The Cultural revolution 1966 disrupted the activity, and the birth rate increased again. In 1969 a very strong drive was started which now shows successful results.

Estimated birth rates

When the birth rates are not given it is possible to estimate these from the number of children in different ages, supposing that migrations and deaths of children can be neglected. The results are:

Tung Chin, Peking

The number of pre-school children indicate an average birth rate of 17 per 1000 in 1964-71.

Rainbow Bridge, Shanghai

1955-59	1 150 births/year	> 44*	birth rate/1000
1959-64	806 "	> 31*	"
1971	425 "	16	"

* Referred to present population. As presumably the population was smaller earlier, the figures are lower limits.

Conclusions

It is obviously dangerous to draw general conclusions from this very small material. However, the general picture is very similar in Peking, Shanghai, and Canton, and the local authorities report that their achievements are characteristic for large parts of China, although not for the more remote parts.

There is obviously at present a decided drive for reducing the birth rate and it seems to be conducted in a very competent and efficient way. There are strong indications that a demographic transition from a birth rate above 40 per 1000 to 15-20 per 1000 has taken place in large parts of China and possibly is under way in most of the country. This conclusion is supported by Japanese observers reporting a birth rate of 13.9 per 1000 for a village near Shanghai.

The success may partially be due to the structure of Chinese society. Because the People's Communes and other subunits have a certain degree of economic autonomy, a reduced birth rate gives an immediate benefit which everybody understands. For example, if the birth rate had not been reduced, the Rainbow Bridge Commune would have had about 5 000 more inhabitants. With equal production the per capita income would have been 20 % less. To this should be added that the care and education of children requires less work and its standard can be raised. There are also obvious benefits to the health and working capacity of the women. Hence already in a 10-year period the reduced birth rate gives a very substantial increase in the standard of living of the whole commune.

27th Pugwash Conference on Science and World Affairs
Munich, 24-29 August 1977

Programme

	a.m. pre-coffee	a.m. post	p.m.	evening
Tuesday, 23 August	Registration		Registration	Informal get-together
Wed. 24 "	Opening (Plenary I) *		Working Groups	Reception
Thurs. 25 "	Working Groups		Working Groups	Plenary II
Fri. 26 "	Working Groups		<--- Excursion --->	
Sat. 27 "	Working Groups	Plenary III	Plenary III contd.	Reception
Sun. 28 "	Working Groups	Plenary IV	Plenary IV contd.	Plenary V * (special meeting)
Mon. 29 "	Closing (Plenary VI) *			

Plenary II: "Future of Pugwash: Issues and Choices".
There is to be a panel of 3 introductory speakers (approx. 10 minutes each) followed by a general discussion. Reports from national and regional Pugwash groups and proposals of the Pugwash Council will be circulated in advance.

Plenary III: Reports from the Working Groups.

Plenary IV: "Future of Pugwash: Activities and Organization".
This will be a discussion of proposals prepared in advance by the Council and those developed during the Conference.

Plenary V: A group of distinguished speakers, allotted about ten minutes each, will present their views on "Scientists and Problems of Peace", followed by questions and discussion from the floor. We hope to record the session on TV tape for subsequent transmission in different countries. The list of panel speakers will be circulated in due course.

Plenary VI: Adoption of public statement and proposals for future of Pugwash, and election of officers.

* Attendance at the various sessions will be restricted to officially invited Conference participants and observers, except for special guests and the press who will attend parts of the opening and closing sessions, and Plenary V. Registration and all sessions will take place at the hotel Bayerischer Hof.

ADDRESS to the
COLUMBIA UNIVERSITY CONFERENCE
ON
INTERNATIONAL ECONOMIC DEVELOPMENT

BY

ROBERT S. McNAMARA

PRESIDENT, WORLD BANK GROUP

New York, New York
February 20, 1970

I am pleased to be here, because your deliberations in this conference on the Report of the Pearson Commission are most timely. They are a preface to the Second Development Decade. They are addressing the issues on which a sound, sensible strategy for the Seventies must be fashioned. After the past quarter-century of experience, governments in the more affluent nations no longer question the general need for global development. What they do question—and what they have every right to question—is whether or not the specific programs of the past are still relevant to the problems of the present, and the imperatives of the future.

Decision-makers in these governments—under the understandable pressures of competing priorities—need a clear view of development goals, and a workable set of options designed to meet those goals. They need practical, politically-feasible programs that can command and sustain legislative and popular support. What is particularly valuable about the Pearson Commission Report is that it realistically addressed itself to that need, and it is clear from announcements by governments in the past several weeks that already the work of the Commission has had an impact:

- Chancellor Brandt of the Federal Republic in addressing the Bundestag has announced: "The Federal Government will endeavor to attain the aim envisaged in the

Report of the Pearson Commission for a public share in development aid by an annual average increase rate of 11 per cent. . . . The number of German development experts and volunteers will be increased with a view to doubling it by the mid-seventies. The Federal Government will continue to improve the quality of German aid."

- Prime Minister Wilson, calling the Report "one of the most important documents of the twentieth century," announced increases in Britain's Aid Program for each of the next three years. And Judith Hart, the Minister for Overseas Development, stated in Parliament: "Taking a high estimate for private flows, we could expect to reach the 1 per cent target not much after the date of 1975 recommended by the Pearson Commission. In any case, the Government intends, unless our balance of payments should preclude it, to reach the target of 1 per cent total flow not later than the end of the Second Development Decade."

- The King of Norway, in his speech from the throne, announced: "The Government has worked out a framework plan for state aid to the developing countries, which will involve a tripling of the amount made available between the years 1968 and 1973."

- Prime Minister Holyoake of New Zealand has pledged that his Government will aim to meet the Pearson Commission target of 1 per cent of Gross National Product in external aid.

- Prime Minister Sato of Japan has stated that economic aid would double in the near future, rising from the present level of $1 billion per year to $2 billion.

France is already providing official development assistance in amounts exceeding the Pearson targets. And Sweden, before the Report was published, announced it was increasing budgetary appropriations for aid by 25 per cent per year which will permit it to achieve the targets by 1975. Similarly, in The Netherlands,

the Government has requested Parliament to provide for fiscal year 1970 a 21 per cent increase in foreign aid, and a still further increase in 1971.

All of this lends encouragement to the view that the decline in official foreign aid is now reversing itself. The trend in the richer countries is manifestly to make more official aid available —with one overwhelming exception. And that is in the richest country of all: the United States. This is, of course, ironical in view of America's performance in the past.

In the whole of history there has probably never been a more thoroughly successful program of assistance than the Marshall Plan. The economic vitality of Western Europe today stands as a witness to its wisdom. The resources the United States committed to this effort were generous, but realistic, and the results in benefits to the entire Atlantic community, including America, have fully justified the investment.

In 1949, at the beginning of the Marshall Plan, American economic aid amounted to 2.79 per cent of its GNP, and 11.5 per cent of its federal budget. In FY 1970, the AID programs constitute less than one-fifth of 1 per cent of the GNP, and less than 1 per cent of the total federal budget. The United States now ranks ninth in the proportion of GNP devoted to aid.

But despite this present adverse trend in America towards foreign assistance, there are signs that the situation will improve. The President is firmly committed to the principle of development aid, and is supporting it. When he signed the Foreign Assistance authorization bill, he stated: "It is my personal conviction that such assistance remains vitally necessary if we are to effectively cooperate with less wealthy countries struggling to improve the lives of their citizens." In appointing the Peterson Task Force on International Development, he charged its members to come up with new and creative proposals. The President is seeking renewal, reform, and innovation in U.S. foreign aid policy, not stagnation.

No one can question that American domestic problems—particularly in the social and environmental fields—require in-

creased attention and funding. But it is wholly unrealistic to suppose that this can only be achieved at the cost of cutting off aid to desperately poor nations abroad. The argument is sometimes made that rich countries must first take care of their own poor before worrying about the poor of other nations. Charity, after all—we are reminded—begins at home.

But I suggest that this argument, while appealing, misses the point. The President has pointed out that in the next ten years the U.S. will increase its wealth by 50 per cent and that the Gross National Product in 1979, at constant prices, will be $500 billion greater than last year. The fact is, then, that the American economy is so immense it can readily support a just and reasonable foreign aid program, within the general dimensions outlined by the Pearson Commission Report, and at the same time deal justly and effectively with domestic needs. The country is clearly wealthy enough to afford allocating a realistic percentage of its expanding resources to both tasks: to assist in alleviating underdevelopment both at home, and abroad.

There is no lack of capacity in the American economy to meet this twin set of responsibilities. What may be lacking is a broad commitment of the national will to do so. Or perhaps the deficit is not so much a lack of national will, as a lack of national understanding; not so much a case of a people indifferent to their responsibilities, as a case of understandable confusion over the competing claims on their attention and resolve.

What is certainly true is that the decision to respond both to the pressures of domestic problems, and the urgency of essential foreign assistance is, in the end, dependent on the response to a far more basic and searching question—a question that must be faced not in the United States alone, but in every wealthy, industrialized country of the world. And that question is this. Which is ultimately more in a nation's interest: to funnel national resources into an endlessly spiraling consumer economy —in effect, a pursuit of consumer gadgetry with all its senseless by-products of waste and pollution—or to dedicate a more reasonable share of those same resources to improving the fundamental quality of life both at home and abroad?

The dilemma that faces the wealthy nations of the world is not whether they should devote more of their GNP to solving domestic crises, and less of it to helping eliminate inhuman deprivations abroad; but rather whether they are going to seek a more equitable balance between private opulence and public responsibility. Private wealth cannot be preserved and public responsibility cannot be met by a heedless indifference to common crises that in the end will touch rich and poor alike.

What we must grasp is that gross measures of economic strength and gross measures of economic growth—for example, levels of GNP or rates of change of GNP—as necessary as they are, cannot measure the soundness of the social structure of a nation. The United States itself is a classic illustration of this truth. Technologically the most advanced society on earth, it produces the greatest GNP ever recorded in history, and enjoys a per capita income that is 30 times greater than that of the peoples in a quarter of the nations of the world.

But what do such figures mean when we remember that even for the affluent, life is beset by smog, pollution, noise, traffic congestion, urban violence, youthful disaffection and a terrifying increase in the drug problem? Worse still, the wealthiest society on earth has within its midst more than 20 million people so poor that their lives verge on mere subsistence. In 1967, 10 per cent of all white families and 35 per cent of all black families in America lived beneath the poverty line.

The poor in America are like the poor everywhere. Statistically their economic condition is improving, but the progress is so slow in relation to the more advantaged groups in society that they are actually growing poorer relative to the rich. The point is illustrative of a phenomenon common throughout the world. Though men have inhabited the same planet for more than a million years, they coexist today in communities that range in the extremes from stone-age simplicity to space-age sophistication.

That degree of inequality would not, perhaps, be as socially and politically explosive as it in fact is, could it remain a well kept secret. For centuries stagnating societies and deprived peo-

ples remained content with their lot because they were unaware that life was really any better elsewhere. Their very remoteness saved them from odious comparisons. But the technological revolution has changed all that. Now, with the transistor radio and the television tube in remote corners of the world dramatizing the disparities in the quality of life, what was tolerable in the past provokes turbulence today.

And what else but turbulence could one expect on a planet linked by instantaneous communication but fragmented by conspicuous inequality. It is inconceivable that one-quarter of mankind, moving forward into a self-accelerating affluence, can succeed in walling itself off from the other three-quarters who find themselves entrapped in a self-perpetuating cycle of poverty.

It is not too much to conclude that the nature of the principal threat to the nations of the world today is internal strife rather than external aggression. In the case of the United States, that is precisely what Dr. Milton Eisenhower did conclude in his final report as Chairman of the National Commission on the Causes and Prevention of Violence. He was clear and emphatic in his analysis: "Our most serious challenges to date," he told the President, "have been external—the kind this strong and resourceful country could unite against. While serious external dangers remain, the graver threats today are internal."

The outlook for the Seventies is that the fault line along which shocks to world stability travel will shift from an East-West axis to a North-South axis, and the shocks themselves will be significantly less military and substantially more political, social, and economic in character.

In view of this, it is tragic and senseless that the world today is spending $175 billion a year on armaments—a sum so huge that it is 25 times larger than the total spent in all foreign assistance programs. What is even worse is that defense spending is increasing by some 6 per cent a year, a growth rate in destructive power that is greater than the growth rate of the world's total production of all goods and services. And the final irony in this litany of irrationalities is that arms spending in the less

developed countries is rising at the rate of 7.5 per cent a year, as against the world average of 6 per cent.

Prudent military preparedness has its place. Prodigal military proliferation is human folly at its worst.

Now as I have pointed out, growth rates of GNP are entirely valid and necessary economic indicators, but they are not adequate measures of the development of a nation. Nor are they satisfactory terms in which to frame the objectives of development programs.

In the First Development Decade, the primary development objective, a 5 per cent annual growth in GNP, was achieved. This was a major accomplishment. The 5 per cent rate exceeded the average growth rates of the advanced countries during their own early stages of progress in the last century. But this relatively high rate of growth in GNP did not bring satisfactory progress in development. In the developing world, at the end of the decade:

- Malnutrition is common.
  The FAO estimates that at least a third to a half of the world's people suffer from hunger or nutritional deprivation. The average person in a high standard area consumes four pounds of food a day as compared with an average pound and a quarter in a low standard area.
- Infant mortality is high.
  Infant deaths per 1000 live births are four times as high in the developing countries as in the developed countries (110 compared with 27).
- Life expectancy is low.
  A man in the West can expect to live 40 per cent longer than the average man in the developing countries and twice as long as the average man in some of the African countries.
- Illiteracy is widespread.
  There are 100 million more illiterates today than there were 20 years ago, bringing the total number to some 800 million.

- Unemployment is endemic and growing.
  The equivalent of approximately 20 per cent of the entire male labor force is unemployed, and in many areas the urban population is growing twice as fast as the number of urban jobs.

- The distribution of income and wealth is severely skewed.
  In India, 12 per cent of the rural families control more than half of the cultivated land. And in Brazil, less than 10 per cent of the families control 75 per cent of the land.

- The gap between the per capita incomes of the rich nations and the poor nations is widening rather than narrowing, both relatively and absolutely.
  At the extremes that gap is already more than $3,000. Present projections indicate it may well widen to $9,000 by the end of the century. In the year 2000, per capita income in the United States is expected to be approximately $10,000; in Brazil, $500; and in India, $200.

Just how much worse these conditions are at the end of the decade than they were at the beginning is difficult to determine. For most of them, even today, we lack satisfactory indicators and data. The result is that trying to plan to improve these conditions, in the absence of such measures and indicators, is like trying to plan price stabilization without price indices. It is an impossible task.

The lesson to be learned is that in setting the objectives, planning the programs, and measuring the progress of development in the Seventies, we must look to more than gross measures of economic growth. What we require are relevant "development indicators" that go beyond the measure of growth in total output and provide practical yardsticks of change in the other economic, social, and moral dimensions of the modernizing process. To limit our attention to expanding GNP, even though it be from 5 per cent per year to 6 or 7 per cent, can only lead to greater political, social and economic disequilibrium. However impor-

tant an increase in GNP may be as a necessary condition of development, it is not a sufficient condition.

This is not to say that the Pearson Commission and Tinbergen Committee target of reaching a 6 per cent annual growth rate of GNP for the developing world in the Seventies is not both feasible and necessary.

It is feasible if those of us in the wealthier world will complement the growing savings of the developing countries by moving toward the development assistance objectives endorsed by both these distinguished groups. And it is necessary, if the broader objectives of development are to be met.

But if we achieve the "quantity" goals, and neglect the "quality" goals of development, we will have failed. It is as simple as that. We will have failed.

The Second Development Decade gives us the opportunity to establish and pursue "quality" goals of development with new insights, new strategies, and new emphases.

With that in mind, I would like to put before you one or two points on the possible role of the World Bank in this new task of seeking quality in the process of development. As a Bank we are naturally committed to the continuance and expansion of our role of mobilizing capital and using it for growth of the productive capacity of the developing nations. We plan during the five years 1969-73 to increase our lending by 100 per cent over the level of the previous five years. The very great advances in the developing countries' skills and infrastructure over the last decade have broadened the opportunities for productive investment, and we are determined at the Bank to take full advantage of them.

But—and I repeat the point—we cannot content ourselves with the mere quantity of our operations if they are not adding to the genuine quality of man's life on the planet. And if our investments are to meet this wider goal, I frankly admit that we and other investors need to add to the patterns of analysis a new dimension of social concern.

This concern must, of course, be as rigorous, factual and informed as any of our other economic analyses and forecasts.

We do not want simply to say that rising unemployment is a "bad thing" and something must be done about it. We want to know its scale, its causes, its impact and the range of policies and options which are open to governments, international agencies and the private sector to deal with it.

We do not want simply to sense that the "green revolution" requires a comparable social revolution in the organization and education of the small farmer. We want to know what evidence or working models are available on methods of cooperative enterprise, of decentralized credit systems, of smaller-scale technology, and of price and market guarantees.

We do not want simply to deplore over-rapid urbanization in the primary cities. We want the most accurate and careful studies of internal migration, town-formation, decentralized urbanism and regional balance.

These issues are fully as urgent as the proper exchange rates or optimal mixes of the factors of production. The only trouble is that we do not know enough about them. I would go further and say that, up to a point, we do not even know how to think about them. Just as the censuses of the 1950's helped to alert us to the scale of the population explosion, the urban and employment crises of the Sixties are alerting us to the scale of social displacement and general uprootedness of populations which are exploding not only in numbers but in movement as well. But we are still only picking up the distress signals. We still do not know how to act.

We should be frank about this. As we enter the Seventies, in field after field, we have more questions than answers. Our urgent need is for new instruments of research and analysis with which to dispel our ignorance of the social dimensions of economic change and help us formulate a more comprehensive strategy for the decade ahead.

We in the World Bank cannot, of course, alone and from our own resources, provide all the new information and expertise

demanded by the scale of our ignorance. But we can stimulate and be part of a wider effort of research and education, and we can help draw together new resources for the formulation of wise development policies. We propose to seek the cooperation of universities, foundations, research units, other international institutions, and experienced administrators for that purpose.

Further, to provide a solid foundation for consultation and action by both developed and developing nations, in the whole field of development strategy and administration of aid, we plan a new and expanded program of Country Economic Missions. These will be regularly scheduled, thoroughly staffed, comprehensive missions whose mandate will be to assist the member government to draw up an overall development strategy which will include every major sector of the economy, and every relevant aspect of the nation's social framework.

One significant innovation in these missions is that the team itself will include representatives from the UNDP, who will play a central role in working out a pre-investment program, so that future development financing may be on a firmer foundation. Where appropriate, the team will include agricultural specialists from FAO, educational specialists from Unesco, medical officers from WHO, and employment experts from ILO, as well as other competent consultants in specialized sectors.

Our own Bank staff on the mission will be looking into not only the traditional problems of economic growth, but the other facets of development as well: questions of population increase, urbanization, land reform, income distribution, public health, environmental preservation, and all the related issues. Once the mission is completed, we will promptly produce for use by all of the parties concerned a thorough Economic Report which will serve as a profile of the country's progress, and of its overall development plan.

In our larger member countries—those containing 80 per cent of the population of the developing world—we will undertake these new Economic Missions annually; in other member coun-

tries, every two or three years. The essential point is that they will be comprehensive in scope, regular in schedule, and will form the basis for strategic rather than merely tactical development financing.

Perhaps one of the most wasteful mistakes that both developing countries and aid agencies can make is to proceed on a random project-by-project basis, rather than first to establish an overall development strategy, and then select projects that mutually support and interlock with one another within that overall plan. Our new program for Country Economic Reports is designed to provide a foundation for such a strategy.

• • •

All of us, within the worldwide community, have a mandate in common. Our ultimate goal is to help build the planet into a more habitable home for mankind, and to help create a political, social and economic environment in which individual men and women can more freely develop their own highest potential.

The funds we require to accomplish this are small compared with the funds the wealthy nations are already devoting to prodigiously disproportionate objectives.

The talents and managerial skills we require are at hand. We only need to organize them.

Finally, the most important ingredient of all—the dedication, the drive, the determination to see the task through—is, I believe, within our grasp. If development becomes a social as well as an economic objective, if it aims squarely at an end of grinding poverty and gross injustice, I believe it has a constituency waiting for it among the emerging generation of young adults. These young men and women are looking for goals beyond their own personal affluence. Human development is surely a challenge that can command their dedication, provided it is a development not simply in goods and gadgets but in the self-respect and dignity of man.

That, I believe, is the true dimension of the task that lies before all of us in the Second Decade of Development.

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Science Policy Research Unit
Third Report 1969

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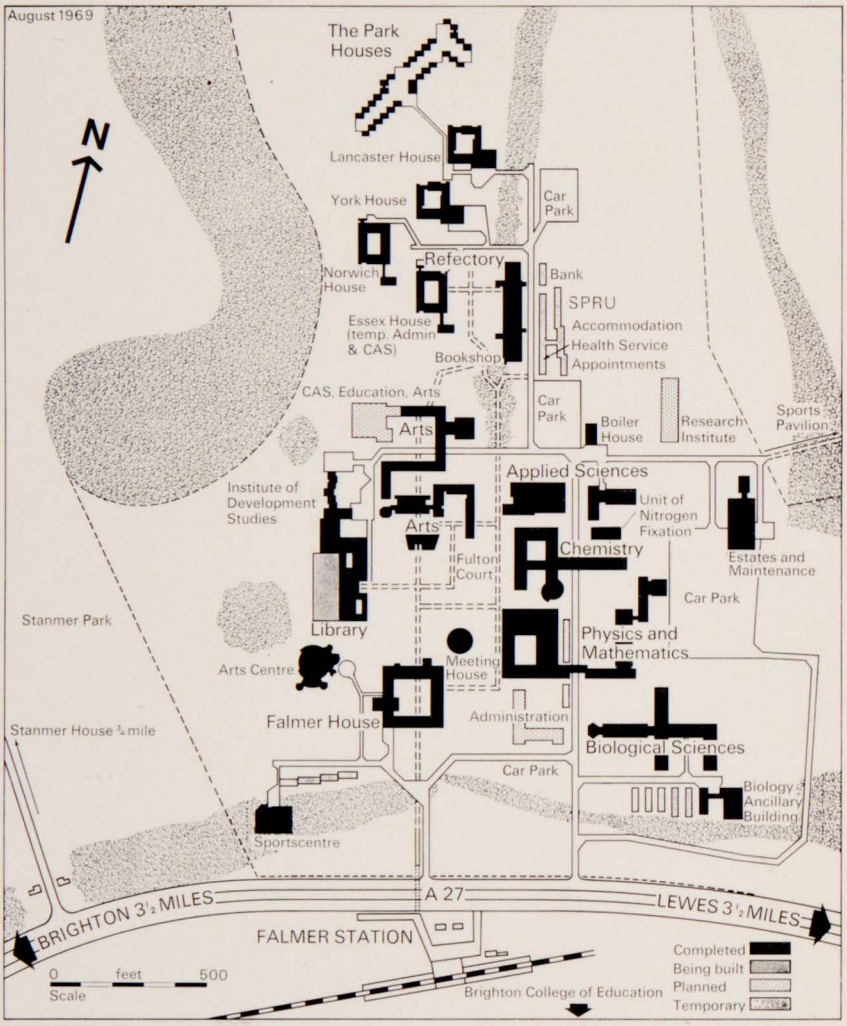

Science Policy Research Unit
Third Report 1969

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Director of SPRU

Contents

Introduction

The Science Policy Research Unit at the University of Sussex was set up in 1966 as a result of the initiative of members of the teaching faculty representing a variety of disciplines. Its work is based in principle on the joint research of natural and social scientists. The Unit's total staff now numbers about 30, evenly divided between these disciplines. On most projects natural scientists or technologists are working together with social scientists.

The primary aim of the Unit is to contribute through its research to the advancement of knowledge of the complex social process of research, invention, development, innovation and diffusion of innovations, and thereby to a deeper understanding of policy for science and technology. It aims to study the research-innovation complex of events in industry and in government, as well as in universities, and in the context of the environment in developing countries as well as in industrialized societies. Whilst most of its work is focused on contemporary problems of policy for science and technology, including forecasting problems, it is also concerned with the historical evolution of the scientific community, of its professional organisations, and of the advisory and executive organs of government concerned with the formulation of science policy.

Effective research into contemporary problems of science policy demands close contact with policy-makers in government and industry. For this reason the Unit undertakes a substantial amount of research under contract, or on a consultancy basis, for government and international agencies as well as for industrial organisations, but it does not undertake military or related classified work. The major part of the Unit's work is financed by contracts and grants from extra-mural sources. The principal projects in hand are described on pages 6–16.

Whilst the Unit is primarily a research organisation, it is contributing increasingly to undergraduate and postgraduate teaching. The research topics of postgraduate students in 1969 are listed on page 17. The Unit is also involved in the training of visiting Research Fellows from overseas and in other postgraduate courses in the social studies of science.

From its inception the Unit has enjoyed close relations with similar research groups overseas and several of its projects have been on an international co-operative basis or for international organisations.

Principal Research Areas

1 Research and Innovation in Industry

In its studies of industrial innovation the Unit aims to contribute to fundamental knowledge of the factors affecting successful innovation, but it also intends to relate this knowledge to the specific problems confronting the British economy. For this reason the Unit has conducted a series of studies, supported by the Ministry of Technology, on the relationship between innovation and the world export market for key product groups. The most recent of these is on heavy electrical engineering. The Unit is also concerned with the problems of forecasting technological change in industry and intends to continue work in this area following completion of the project for the Engineering Industry Training Board described below. The Unit's long-term fundamental work on industrial innovation is concentrating on the explanation of *failure*. Hitherto, most studies have concentrated on the description of success and many plausible hpyotheses have been advanced to explain this success. However, it is not possible to discriminate between alternative hypotheses unless failure in innovation is also taken into account. For this reason, the work described below in relation to Project SAPPHO will be continued on a long-term basis until it is possible to make tested generalisations about the innovative process, industry by industry.

(*i*) *Patterns of Discovery, Invention and Innovation*

'Project SAPPHO' is a three-year study of patterns of innovation in chemicals and scientific instruments, which began in 1968. It is supported by a grant from the Science Research Council. Mr A. B. Robertson is leading the project, assisted by Mrs C. M. Tudway (until April 1969), Mr P. Jervis on the instruments sector and Dr B. Achilladelis on chemicals (both from October 1969). Mr R. C. Curnow, who designed the conceptual framework of the project, is responsible for the coding and computer analysis of the results.

The project aims to find 'pairs' of attempted innovations in closely similar technological areas or with identical market objectives. In each 'pair' there is a relatively successful innovation and a relatively unsuccessful innovation or failure (in market terms in both cases). As many characteristics as possible of each innovation case history are identified and quantified where practicable and the information is then coded. Analysis of the data will be undertaken by means of a computer program which was initially set up to examine simultaneously evidence for and against various hypotheses previously suggested as pertinent to successful innovation. This pattern finding is the main feature of the program suites but the data in hand is suggestive of new hypotheses. To preserve objectivity these hypotheses will be tested on later data and an appropriate filter will be provided for this purpose.

The original target for each industry sector was fifteen 'pairs', making sixty case histories in all. In fact by mid-1969 about twenty instrument 'pairs' had been identified and several had been completed, with good prospects of completing more than the original fifteen during 1970. Progress in chemicals has

been a little slower, with sixteen possible 'pairs' identified but only one complete by mid-1969.

From the completed cases it is apparent that the paired comparison method promises to throw some interesting light on the innovation process, provided the data can be assembled with the full cooperation of the organisations involved. Information from firms is, of course, treated as strictly confidential. The possibility of widening the industrial area under scrutiny by the addition of sectors such as electronics and engineering is being explored.

(*ii*) *Technical Change and the Demand for Manpower and Training in the Engineering Industry*

This project, sponsored by the Engineering Industry Training Board, has now entered its second year. The team working on the study are Mr P. A. Shears, Mr R. M. N. Bell, Mr D. M. Waddilove (until September 1969), Mr A. Leaman and Mr T. Smith (both from September 1969). Mr C. H. Flurscheim is acting as Consultant.

The objectives of the project are to devise a method for predicting the effects of changes in technology on manpower and training requirements and to produce results for a small number of selected occupation/sector areas that will enable the EITB to modify manpower demand extrapolations to take account of major shifts in the rate or direction of technical change. The original project design envisaged three phases to the work: the identification of the most significant technological changes, the measurement of the manpower impact of such changes, and the estimation of rates of diffusion through the mid-1970's of the 'new' technologies.

The first phase has been completed. A wide-ranging survey has considered the possible impact on manpower requirements of a large number of technical developments in the engineering industry, and valuable contacts have been established with American and German workers in this field. For the second phase, it has been decided to concentrate the main research effort on forecasting the effects of changes in the technology of batch production machining. This is an area of very large employment where a number of technical and organisational developments seem likely to have a significant effect in altering the pattern of labour input required. Because of the variety of changes in technology and the complexity of the process-route network of the engineering industry, it has not been found possible to rely solely on the diffusion-based forecasting approach. It is hoped to carry out a number of controlled plant and manpower comparisons and to forecast changing patterns of investment in plant and machinery in order to arrive at overall manpower demand forecasts for this area.

It is hoped to support this main study by complementary work designed to take account of the effect of the supply of manpower and training on the rate and direction of technical change (the reverse procedure). The potentialities for substitutability between various categories of manpower and its effect on the form taken by technological developments will be examined; the concept of

technological policy will be developed, and the way in which its formulation and implementation is related to manpower will be studied.

(iii) The World Market in Heavy Electrical Equipment

Work began in July 1969 on a two-year study sponsored by the Ministry of Technology of the factors influencing competitiveness in the world market for heavy electrical equipment, including technical innovation. The project will concentrate on the types of equipment commonly used by electric utilities, namely generating units of 30 MW and above, power transformers and switchgear, and particular attention will be given to UK export performance. The study is led by Mr A. J. Surrey, who will be assisted by Mrs L. L. Hill, a Research Fellow to be appointed, and two part-time engineering consultants (Mr C. H. Flurscheim and Mr D. Tompsett).

Among the economic factors to be investigated are home and export prices, credit terms and insurance, standardisation and its influence on costs and prices, and marketing effort. Technical factors include differences in electrical specifications by utilities and in manufacturers' designs, the technical reputation of different manufacturers' equipment and the proven performance of equipment in 'captive' home markets. Other factors to be examined include national purchasing policies, traditional links such as colonial ties and the training and background of engineers, the influence of international consulting engineers, aid programmes and various forms of trade discrimination.

In general the approach will be similar to that of the Unit's study of the chemical process plant industry completed in 1968 (see Second Report, 1968).
Card indexes for subsequent computer analysis will be compiled for generating plant, transformers and switchgear installed since 1955 outside the Communist bloc. The cards will record the name of the plant or the site, its owner and the equipment manufacturer, its type, rating or capacity and other main characteristics, its price and the consultants used. Work is under way on compiling the generating plant index using published material and, before the information is coded and punched, electric utilities will be asked to verify and expand the information on their plants. The computer analysis will tabulate the data in various ways and explore the interdependence between the main variables.

An attempt will be made to build up a picture of trade in the relevant categories of heavy electrical equipment from the trade accounts of the leading exporting countries of heavy electrical equipment. Complementing this will be an analysis of home and export deliveries and of new orders for the chief plant manufacturers.

To provide background information on plant manufacturers, export contracts. and on the international market generally, technical and economic literature will be systematically searched. In 1970, after much of the groundwork has been done, a programme of interviews with the leading plant manufacturers, electric utilities and technical organisations will be undertaken in the UK, USA, Japan, West Germany, France, Sweden and Switzerland.

2 Science Policy and Developing Countries

It has always been an objective of the Unit to pursue studies relevant to science and technology policies on an international basis. One aspect of this work has been the programme of activities and research related to the developing countries. The presence at the University of the Institute of Development Studies has provided an additional stimulus for working in this area and some of the work has been carried out jointly with the IDS. The following are the main projects related to developing countries.

(*i*) *'Ford' Programme on Science Policy and Developing Countries*

Following a four-month 'Travel and Study' award to Dr C. H. G. Oldham, the Ford Foundation provided a three-year grant to the Unit for a programme on science policy and developing countries. The main purpose of the grant is to enable the Unit to build up a resource base of individuals who are studying the problems of science, technology and development. Research Fellows from developing countries will participate in the programme.

Three main projects will be financed by this grant:

(a) *Trade and Technology* The purpose of this study is to make an empirical examination of the influence of differential rates of technological progress in the advanced and the developing countries on the export performance of the developing countries. Initial efforts have been concentrated on literature search and methodological work and some preliminary analysis of trade data will now be undertaken. It is intended that the project should include both an analysis of trade data *per se* and also a study of the transfer of technology between developed and developing countries. It will be policy-oriented and will attempt to define the implications for science and technology policies in developed and under-developed countries arising from the influence of technological factors on world trade patterns. Mr C. M. Cooper is leading this project, assisted by Mr S. Barrio.

(b) *Science Policy in China* The problem of access to information precludes any major study of Chinese science policy. Nevertheless, a continuing effort will be made to keep abreast of the main developments in Chinese policies for science, and a more detailed study of the Chinese scientific instruments industry will be carried out. Dr C. H. G. Oldham will lead this work, assisted by Miss G. C. Dean.

(c) *The Generation and Diffusion of Innovations in a Developing Country* The purpose of this project will be to study the problems of linkage between the products and innovations generated in research laboratories and their use by society. Preliminary methodological studies have already been made and it is anticipated that field work in a specific developing country will begin in 1970. Mr R. M. N. Bell and Dr S. C. Hill will be working on this project.

(ii) The Scientific Instruments Industry in India

This project aims to study the problems associated with the establishment and growth of a science-based industry, giving special attention to the transfer of technology both within India and from abroad. It is led by Mr J. A. Bennett, assisted by Mr N. G. Clark and Mr P. Jervis (until September 1969), and is financed by the Ministry of Overseas Development. The project co-ordinator in India is Dr A. Parthasarathi.

During the year attention has been directed to three aspects of the project: base data relating to the Indian instruments industry, the process of technology transfer both from sources in India and from outside, and the pattern of imports by the Indian instruments sector.

Mr Bennett and Mr Clark went to India in October 1968 to undertake the survey of the scientific instruments manufacturers with the help of field workers from the Department of Atomic Energy and representatives of the All India Instrument Manufacturers and Dealers Association. The first task was one of identifying the instrument manufacturers and, from an initial list containing some 1,200 names, 450 firms were identified as manufacturers of scientific instruments within the classification adopted for the project. This included medical, educational and process control instruments, together with instrumentation required for research and development. Data has been obtained on the growth of the industry since 1963 in terms of employment and sales, as well as estimates of future growth. A detailed breakdown has been made of sales by instrument types, the volume of sales via dealers and the total value of exports. Data has also been obtained on the value of components and material purchased by the industry both from within India and from abroad. A full analysis of the data obtained from the manufacturers' survey is currently being undertaken.

The incidence of foreign collaboration agreements has been compiled from Government of India lists and also from the manufacturers' survey data. A sample of such agreements is being studied in depth with a view to understanding those factors which lead to a successful collaboration. Economic and technical, as well as social, aspects of the collaboration are being studied and interviews are being held with both parties to the agreement.

The pattern of imports of instruments by India is being analysed. Mr Jervis has compiled a data bank of the nationally reported imports from each foreign country for each year since 1963. It is being analysed by computer to show the value of imports by product type and country of origin over the period. The pattern of imports will be related to the pattern of indigenous manufacture in order to establish the total supply of instrumentation to the Indian economy.

(iii) The Movement of Commonwealth and Other Doctors to the United Kingdom

This two-year study, which began in October 1968, grew out of earlier work on the 'Migration of Scientific Talent' (see Second Report, 1968). The Social Science Research Council is supporting this project, which is led by Mr O. Gish. He has been assisted by Drs M. J. A. de Maar during the first year of the study.

The major purposes of the project are: to collect statistical data about

overseas doctors (demographic and migratory information as well as training experiences); to analyse the experiences of overseas-born doctors who had undergraduate medical training in Britain; to investigate the consequences of the presence of overseas doctors in Britain both upon the health services of the countries from which they come and in Britain; and to study some questions associated with the emigration of British doctors.

Statistical data is being assembled from material obtained from the Ministry of Health and a survey of medical schools conducted in order to gather information about overseas-born graduates of British medical schools. Visits will be made to India, Pakistan and other countries to locate specific doctors who have left Britain for these countries in recent years. An attempt will be made to relate their present medical work to the training they received while in Britain.

Some of the major findings on this project during the first year were as follows. One out of every four doctors employed by the National Health Service was born outside the British Isles (the 3–4,000 Irish doctors are not included as part of the immigrant category). Not all the 14,000 overseas born doctors are part of the group usually thought of as immigrants – these are the 5–6,000 doctors who were born in Europe or the Old Commonwealth countries (and South Africa) – but around 8,000 others came from the New Commonwealth or other countries with British colonial ties. In 1967 as many overseas doctors came to Britain to begin the practice of medicine as there were graduates of British medical schools (about 1,900 in each case), but most of the immigrating doctors do not remain permanently in Britain. There is an increasing circulation of doctors who 'pass through' the British hospital system and the stock of such doctors who are in Britain at any one time is increasing by about 500 per year.

(*iv*) *Bibliographic Study of Science, Technology and Development*

A grant from the Canadian International Development Agency has enabled a classification scheme and card file to be prepared for the literature on science and technology policy as it relates to the developing countries. The coded information is being transferred to punch cards to facilitate analysis and sorting. It is anticipated that work on annotation and the preparation of a review paper will continue. Miss G. C. Dean is directing this work and was assisted by three Sussex University students during the summer vacation.

3 Social Studies of Science

From its inception the Unit has recognised that social welfare aspects of the research and innovation system are of critical importance in the formulation of science policy. The Unit's historical studies of the endowment of science have brought out very clearly the importance of non-economic criteria in the political decision-making process. In addition to continuing research on the social history of the scientific community and scientific institutions, the Unit has embarked on a major project concerned with human life and safety in relation to technical innovation. This project is central to the long-term aim of the Unit to find ways of relating decision-making in research and development to the future social implications of that research. It is hoped that the techniques of social cost-benefit evolved in relation to this project will contribute to the solution of much wider science policy problems of environmental pollution and other hazards confronting industrialised societies.

(*i*) *Human Life and Safety in Relation to Technical Change*

A study of the effects of technological change on human life and safety began in December 1968 and is sponsored by the Social Science Research Council for three years. The project is led by Mr T. C. Sinclair, assisted by Mr G. G. W. Moring.

The approach is principally economic and comparative and seeks to establish a cost-benefit relationship between the costs of safety precautions in operation and design and the costs of accidents in industry. All injuries, whether industrial or third party, are considered in relation to the activity involved and methods will be evolved for assessing input and output in relation to safety policies. The methodology will be designed to encompass other disamenities such as noise, and air and water pollution. Particular emphasis will be placed on innovation and an attempt will be made to measure the shift of risk with technological advance. The main effort is being concentrated on transport, the electricity industry and pharmaceuticals, as well as some other branches of manufacturing industry.

A critical examination of the statistics relating to industrial accidents has been made and work is in hand to define new methods and parameters for judging safety performance. A computer program has been written to facilitate this. Statistics have also been collected on third party risks arising in the above areas and material assembled for the building up of comparative case studies on the effects on safety and hazard of particular innovations. This has been supplemented to a large extent by information gathered by interview.

In the field of electric power production, numerical indicators of 'technological updatedness' produced in published work have been used to make comparative assessments of the performance of the safety organisations concerned in three countries: UK, USA, and France. Further work to verify this is in hand.

Future work will be concerned with the development of the areas outlined above, particularly with a view to defining 'technical change' in such a way that it can be measured against the deleterious effects involved.

(ii) Historical Studies of Science

During the past year the Unit's historical studies, conducted by Dr R. M. MacLeod, have proceeded chiefly along administrative and sociological lines. Research on the use of science in government and the development of policies for science, begun in 1966 with the aid of a grant from the Council for Scientific Policy, has been gradually extended in emphasis from the nineteenth century to the First World War and the inter-war years. Case studies are in preparation which develop themes demonstrating the relationships between science, administration and law during this period. With the constitutional background to policies affecting science in mind, the significance of organisational and institutional forms for bodies such as the DSIR in Britain and the Commonwealth is being assessed. In addition the relationship between economic conditions, the growth of university science and the employment of science graduates between the wars is being studied. International studies arising from earlier Anglo-German comparisons are advancing with the aid of colleagues in Heidelberg, who have completed the first year of their studies supported by the DFG.

Work has also begun on studying variables underlying scientific activity through the development of scientific publishing during the last century. Work on the history of *Nature* (the scientific journal) and British publishing houses with significant scientific lists, has thrown much unexpected light on the definition of lines of research within the scientific spectrum and on the intellectual context in which these lines are drawn and diffused.

(iii) Historical Archives of British Scientists

This study began in December 1968 and is supported by a grant from the Social Science Research Council. It is led by Dr R. M. MacLeod, assisted by Mrs A. B. Berridge (until August 1969) and Miss S. L. Minden (from September 1969). Miss E. K. Andrews, a former member of the Unit and now at the Research Division (Scientific Section) of the House of Commons Library, has acted as Consultant for part of the archival work and Mr G. G. Moring has assisted in the preparation of computer programs to analyse the data.

The project aims to define the social, economic and political variables which are essential to an understanding of the intellectual and cultural history of science. The development of elite groups and 'outsiders' within science in Britain between 1875 and 1915 is being followed by studying private letters, unpublished biographical material and institutional information concerning over 3,000 men of science in this period. It is hoped that the project will produce archival information about men who rarely figure in current histories of science, yet who made up the chief part of England's learned societies.

This work has been designed to complement that being undertaken by Dr R. E. W. Maddison (Librarian of the Royal Astronomical Society) for the Joint Committee of the Royal Society and the Historical Manuscripts Commission on the archives of eminent British men of science. It is producing

material from which the economic and social background, educational and social mobility, professional interests and occupations, and publication habits can be analysed, as well as the place of individuals in creating and maintaining orthodoxies in scientific thought. The Librarian of the Royal Institution and the Librarians of the major scientific societies have been particularly helpful.

4 Other Work

Other work including short-term projects and consultancy undertaken by various members of the Unit is briefly summarised below.

Mr Freeman continued to work with the OECD and UNESCO on problems connected with the measurement of scientific and technical activities. He participated in the second Frascati Conference in December 1968 and took part in the revision of the *Frascati Manual* on measurement of research and development during 1969. He prepared a review paper for UNESCO on the measurement of 'output' of R and D for their joint Conference with ECE on R and D statistics in June 1969. During September 1969, together with Dr Oldham, he undertook consultancy for the Organisation of American States on technology diffusion and transfer in Latin America and visited Argentina on their behalf. Mr Freeman was a member of the Process Plant Expert Committee appointed by the Minister of Technology and took part in the preparation of its report, which is to be published in 1969. He is also a member of the Research Panel of the new Institute of Manpower Studies at the University of Sussex.

Dr Oldham was a member of the task force established by the Canadian International Development Agency to prepare the legislation for the International Development Research Centre of Canada. He is a member of the Committee of Management of the Contemporary China Institute in London, of the Executive Committee of the Editorial Board of *China Quarterly*, of the Board of Studies of the Institute of Development Studies at the University of Sussex, and is the University representative on the Universities China Committee.

Mr Curnow was seconded to the Economic Commission for Europe of the United Nations in Geneva in February and March 1969 and has continued to work with them on a part-time basis on three projects: first, a world-wide study of machine-based information systems in science and technology has been undertaken, stressing cost-benefits and relevance to users as a precursor to international cooperation in this field; second, a thesaurus of standardised econometric terms and models has been prepared as a potential aid to the improved dissemination of information between the economic research institutes of the ECE region and the USA; third, a model and check-list for the development of governmental technological planning approaches is in progress. Mr Curnow contributed to the International Labour Office project on management development with reference to the use of computers in developing countries, as part of the ILO's programme in the Second UN Development Decade. Detailed proposals were also made by him in September 1969 to the Canadian Government for a feasibility study on an information system for the joint use of the proposed International Development Research Centre and the Canadian International Development Agency. In May 1969 Mr Curnow visited the National Science Council of Ireland to advise on information policy.

Mr Cooper, Dr Hill, Dr Oldham, Mr Freeman and Mr Gish (together with Dr Singer from IDS) were members of the Sussex Group set up by the United Nations during August and September 1969 to prepare an introductory statement to the World Plan of Action for the Application of Science and Technology to Development. Mr Cooper also prepared a review of studies on science and production for the OECD Directorate for Scientific Affairs and was a consultant on their Transfer of Technology Project.

Mr Sinclair gave lectures on 'Safety and Design' to several organisations including the Design Forum of the Industrial Engineering Design Society.

Dr MacLeod was a Visiting Lecturer in the History Faculty and the Victorian Studies Center of Indiana University between February and June 1969, where he gave courses in administrative history and the social and literary history of Victorian science. He also gave guest lectures at the Illinois Institute of Technology Research Institute and at Case Western Reserve University. In the summer of 1969 Dr MacLeod prepared for the Science Policy Division of UNESCO a set of recommendations for the proposed Science Policy Fellowship Programme on the relation of academic research and instruction to the needs of science policy practitioners in both industrialised and developing countries. In spring 1969 he gave eight lectures to the Cambridge University History Faculty on 'Science and Public Affairs'.

Mr Gish designed a questionnaire directed to Commonwealth governments about the effects of migration in their countries for the Commonwealth Secretariat in March and April 1969. Also in April he advised the Ministry of Science and Higher Education of Iran on medical education and the 'brain drain' problem in Iran and in May the Ministry of Finance and Economics of the Sudan on medical education and health planning. In September 1969 he assisted the Labour Party NEC Study Group on Immigration on the migration of highly qualified manpower into Britain.

Mr Jervis has undertaken a project for the Scientific Instruments Manufacturers Association (SIMA), the Scientific Instruments Research Association (SIRA) and the National Economic Development Office (NEDO), which is designed to provide better foreign trade statistics for the major instrument manufacturing countries. The method will be to build up a data bank from the published records of trade transactions in instruments for the relevant countries and to use a computer program to tabulate and analyse the figures. This will give inter-country comparisons in greater detail than is at present readily available from published source material. The project is being run under the supervision of a Management Committee, consisting of representatives from the sponsoring bodies and from the Unit (Mr Bennett and Mr Jervis).

Mr McKnight has written a study for the United Nations Institute for Training and Research (UNITAR) on the Safeguards System of the International Atomic Energy Agency, as a precedent for the verification of treaty obligations. He also acted as a consultant to the International Institute for Peace and Conflict Research (SIPRI) in Stockholm on non-technical aspects of a control organisation.

Mr El Said completed his international study on science policy-making bodies, with special emphasis on the gap between the developed and the developing countries in terms of the types of machinery and the fields covered, and a report was submitted to UNESCO.

5 Postgraduate Research

The following postgraduate work has been supervised by members of the Unit in 1969. It excludes full-time members of SPRU who are registered for part-time postgraduate degrees, as their research topics are normally those of the projects on which they are working.

Supervised by C. Freeman:

(*i*) *A. M. Golding BA(Cantab), MA(Sussex)* A DPhil thesis is being prepared on the diffusion of technology in the semi-conductor industries of the UK and the USA. The final draft of the study emphasises four principal topics within the context of an overall view of the development of the industry. The first section considers the nature of R and D and technological innovation in semi-conductors. The remaining sections deal with three apparently significant influences on the diffusion of technology: patents and licence agreements; government involvement; and the role of small firms. It is hoped to complete the research, which began in early 1968, by March 1970.

(*ii*) *Miss E. K. Andrews BA(Wales) MA(Sussex)* A DPhil thesis is being prepared part-time on science and politics between the wars with particular emphasis on the Department of Scientific and Industrial Research, 1916–39. The work will deal with the institutional growth of the DSIR during the period and the evolution of scientific priorities closely linked to economic and social policies.

(*iii*) *E. W. N. Gilbert CEng MIEE* As the final stage of an MA course in Management Studies arranged jointly by the Brighton College of Technology and and the University of Sussex, an investigation was made of the diffusion of numerical control system innovations into the engineering industries of the UK and Scandinavia. Information in all countries was collected from user firms, non-user firms, government bodies, research associations, unions and employers' federations, etc. Conclusions reached dealt *inter alia* with the effects of union attitudes and social pressures on the diffusion rate, the effectiveness of the government role as a 'change agent' and the training requirements for both operational and maintenance aspects of the innovation implementation.

Supervised by Dr C. H. G. Oldham:

(*iv*) *R. A. Franks MA(Eng)(Cantab)* A dissertation has been written for the MA in Development Economics entitled 'China – some Aspects of Mao Tsetung's Agricultural Development Policies'. The aspects dealt with include rural education, the development of technology and agricultural mechanisation. The central theme is that Mao is attempting to achieve economic and social development 'from below'. Although Mao's first priority is social development, this is not necessarily incompatible with economic growth. On the contrary, it is here argued that it will powerfully reinforce it. The paper deals with policies as

deduced from the Chinese press, but no attempt is made to measure the effectiveness or coverage of implementation.

Supervised by A. B. Robertson:

(*v*) *V. Thomas BA(Aberystwyth)* An MA dissertation has been prepared on the economics of innovation in accelerated freeze drying of foodstuffs. The purpose of the study was to see why one firm succeeded in the innovation where another failed, as part of the SAPPHO investigation (see page 6). Management and marketing expertise were found to be the key factors explaining the different performances of the firms concerned in this particular 'pair'.

Supervised by Dr R. M. MacLeod:

(*vi*) *M. B. R. Eagles BSc(London)* An MPhil thesis is nearing completion on the structure of scientific manpower between the two world wars, 1920–38. For this purpose a survey has been made of those scientists who, as students, applied for DSIR studentship grants during this period. The effect of harsh economic times on the choice, or rather lack of choice, of jobs has been clearly demonstrated and various relationships between career success and grant recommendation have been shown. The dominance of certain universities in particular fields, the influence of eminent professors at these universities, and the ensuing effects on students' lives, including migration and mobility, have been illustrated.

Supervised by R. M. N. Bell:

(*vii*) *C. J. Rumsey ACIS* For an MA in Management Studies a dissertation has been written on the effects of computer systems on organisations: a case study of an oil company's vehicle routing system. The original aim was to investigate the effects of installing a computerised vehicle routing and scheduling system at three of Mobil Oil Co Ltd's fuel terminals. Increasing delays in implementation necessitated shifting the emphasis of the dissertation to an examination of the effects of computer applications on organisations in general, particularly with regard to decision-making. A critical appraisal of published literature in this field is also included.

Supervised by C. M. Cooper:

(*viii*) *M. M. Campos BEcon(Mexico)* A dissertation is being prepared for the MA in Development Economics which will examine the various ways in which imported technologies are adapted to conditions in various less-developed countries. The analysis is based on an examination of case studies of technology adaptations and will categorise the purposes for which adaptations were made in these specific cases. The study will examine the existing theoretical treatments of choice and adaptation of technologies in the less-developed countries, to see how far they are relevant to the practical issues that are revealed by the case materials.

Library Services

Unit Library

At the end of August 1969 the Library moved into a room adjacent to the other Unit offices. This was imperative, as communication between the Library and its users had suffered due to lack of integration.

In spite of this difficulty, however, the Library doubled its stock during the year and there are now some 2,500 books and pamphlets and 1,000 reprints and photocopies. About 90 periodicals are also currently taken.

With work progressing on the CIDA bibliography (see page 11), it was decided to delay re-classification in the Library until the CIDA scheme can be assessed as a possible basis for the Library as a whole.

A great increase in the number of people wishing to use the Library has necessitated a policy towards lending and obtaining material. It was decided that, whilst full facilities would be available to Unit members and postgraduates, a reference service only could be offered to undergraduates, except in those cases where the Library holds multiple copies. The Librarian, Mrs V. Craig-Mair, is happy to deal with outside enquiries as far as possible within the scope of the Library, but loans can be made only in exceptional circumstances. The Library is open from Tuesday to Friday, from 09.30–12.00 and from 14.00–17.00.

Science of Science Foundation Library

The Unit Library was designed as a small working collection to aid research work in progress in the Unit, while the main University Library continues to be the principal repository of books, papers and journals. Access is also available in the University Library to the collection deposited there by the Science of Science Foundation. The SSF Library continues to develop and at present contains about 4,300 items, including some 100 periodical titles, most of which are received currently. The Library is on the mailing lists of many British and foreign organisations and publications are received from all parts of the world. In particular there is a growing collection of Annual Reports of organisations such as government departments, government-sponsored scientific establishments, research institutes and other private and public foundations active in the fields of science and education. Notification of selected additions to the collection is made in the Foundation's bi-monthly *Science Policy News*.

Papers and Publications, 1968/69

C. Freeman	*The Measurement of Scientific and Technological Activities*, UNESCO, Paris, 1969
	Measurement of Output of Research and Experimental Development: a Review Paper, UNESCO, Paris, 1969
	'National Science Policy', *Physics Bulletin*, Vol. 20, 1969, pp. 265–270
	Irish Science Policy, paper delivered at Dublin Conference, June 1969, to be published by the National Science Council of Ireland, 1969
	'Chemical Process Plant: Innovation and the World Market', *New Technology*, no. 29, June 1969 (summary of NIESR study)
C. H. G. Oldham	'Science and Social Change: Politics and the Organisation of Science', Chapter in *The Social Reality of Scientific Myth*, American Universities Field Staff Inc, New York, 1969
	'The Science Policy Research Unit', talk on Radio Brighton, March 1969
	'Ideology and Chinese Society', paper given at University of Toronto Conference, April 1969
	'Science in China's Development', talk prepared for BBC's Chinese Service, August 1969
	'Science and Development: the Chinese Experience', paper given at the Banff Conference on World Affairs, August 1969
	'A Strategy for the Establishment of the International Development Research Centre of Canada', unpublished paper, August 1969
R. C. Curnow	'The Importance of Application Satellites to the European Economy', *The Aeronautical Journal*, Royal Aeronautical Society, Vol. 73, no. 700, April 1969, pp. 306–9
	'Economies of Scale in R and D', *New Scientist*, 22 May 1969, pp. 422–3
	'The Technological Ecology: Technological Evolution Viewed by Analogy with Natural Evolution of Species', to be published by the ECE
	'Government Measures for the Promotion of Industrial R and D and the Stimulation of Technology in the UK', paper prepared for the Studiengruppe für Systemforschung for submission to the EEC

'The Innovation Cycle in the Manufacture and Application of Computer Systems', *Technological Forecasting*, Proceedings of Strathclyde Conference on Technological Forecasting, Edinburgh University Press, 1969

R. C. Curnow and G. G. Moring, 'Project SAPPHO: a Study in Industrial Innovation', *Futures*, December 1968

C. M. Cooper (with F. Chenais), 'The Impact of Advanced Countries' Science and Technology on the Less Developed Countries', to be published by the *Twentieth Century Fund*

(with F. Chenais and X. Mourre) 'International Exchanges of Goods, Capital and Technology', in *The Gaps in Technology between Member Countries:* Analytical Report, Vol. III, OECD, to be published

C. M. Cooper, S. C. Hill, C. Freeman, C. H. G. Oldham, O. Gish (with H. Singer and R. Desai) 'World Plan of Action for the Application of Science and Technology to Development', Introductory Statement by the Sussex Group prepared for the United Nations, September 1969

A. B. Robertson 'The Innovators: Profit or Loss from Industrial Research', *Business Administration*, March 1969

The Management of Industrial Innovation, Industrial Educational and Research Foundation, 1969

'The Business of Business', in *Values in Industry*, Harrap, 1969

(joint Editor with C. de Hoghton), *The Company*, Allen & Unwin, for Political and Economic Planning, 1970

T. C. Sinclair 'Costing the Hazards of Technology', *New Scientist*, Vol. 44, No. 671, pp. 120–2

T. C. Sinclair and G. G. Moring, 'Assessment of Risks arising from Technological Change', to be published in *Futures*, December 1969

R. M. MacLeod 'The Genesis of *Nature*' and 'The Solid Ground of *Nature*', *Nature*, November 1969

'The X-Club in Legend and Fact', *Notes and Records of the Royal Society*, Winter 1969

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O. Gish

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'The National Health Service and the Immigrant Doctor', *The Birmingham Post*, 18 February 1969

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'A Note on Aid for Nursing Training in Britain', *The Journal of Development Studies*, Vol. V, no. 3, April 1969

'Nursing and Midwifery Migration in Britain', *Nursing Times*, Vol. 65, no. 18, 1 May 1969

'The Movement of Commonwealth and other Doctors in the United Kingdom', *The Institute of Race Relations Newsletter*, Vol. 3, no. 3, March 1969

'Research on Health Manpower', *Bulletin of the Institute of Development Studies*, Vol. 1, no. 4, May 1969

'Britain and America: Brain Drains and Brain Gains', *Social Science and Medicine*, Vol. 3, no. 3, October 1968

'Foreign Doctors in Britain and America', *World Medicine*, 26 August 1969

'Emigration and the Supply and Demand for Medical Manpower: the Irish Case', *Minerva*, Vol. VII, no. 4, September 1969

(with J. Wilson) 'Emigrating British Physicians', *Social Science and Medicine*, to be published

'Graduates of British and Irish Medical Schools in the United States', *Social Science and Medicine*, to be published

Britain and the Immigrant Doctor, Institute of Race Relations Briefing Paper, London, June 1969

'Medical Migration in Britain', chapter in *The International Migration of Talent*, to be published by Education and World Affairs early 1970, Washington/ New York

'Health Planning in Developing Countries', chapter in *Social Planning*, London, Frank Cass, to be published in April 1970; and as a special edition of *The Journal of Development Studies*, April 1970

O. Gish and Miss M. J. A. de Maar, 'European Medical Graduates taking American State Board Examinations, 1946–67', *Cahiers de Sociologie et de Demographie Medicales*, IX Annee, no. 3

'Graduates of British and Irish Medical Schools taking State Board Examinations in America', *British Journal of Medical Education*, vol. III, no. 3, September 1969

O. Gish and A. B. Robertson, 'Where Immigrant Doctors Go – and Why', *New Statesman*, 14 March 1969

S. C. Hill

'Some Problems of Research Management in Australia', *Proceedings of the Royal Australian Chemical Institute*, July 1968, pp. 173–7

'A Natural Experiment on the Influence of Leadership Behaviour Patterns on Scientist Productivity', to be published in *Soziale Welt*, Final Quarter, 1969

(with A. H. Rubenstein *et al*) 'Some Data on Applied Research Institutes in Developing Countries', paper delivered at the Conference of the Operations Research Society of America, Miami (Florida), November 1969

'Swimming with Sharks and other Field Study Techniques for Maximising Subject Response', to be published

'The Values of Australian Industrial Scientific Researchers: a Test of Influence Exerted by the Social System of Science', to be published

	'A Theory of Group Structure based on Values', to be published
	(with W. Byrt) 'Management is . . . Planning', a book under final preparation for publication in Australian paperback
S. Barrio	(with C. Brundenius, J. Ricklefs and L. dos Santos) 'Non-ferrous Metals', Sector Study in Series on *Gaps in Technology between Member Countries*, OECD, 1969
	(with K. Pavitt and J. Ricklefs) 'Performance in Technological Innovation of Member Countries', in *Gaps in Technology between Member Countries:* Analytical Report, Chapter B, OECD, to be published
	(with J. Ricklefs, M. Carmi, K. Pavitt and S. Wald) 'The Economics of Innovation', OECD, to be published
A. D. McKnight and S. Encel, 'Australia and the A-Bomb', to be published in *Australian Outlook*	
M. E. M. El Said	'An International Study of Science Policy-Making Bodies throughout the World, with Special Emphasis on the Gap between the Developed and Less Developed Countries (by Machinery and the Fields Covered)', paper submitted to UNESCO, April 1969
P. C. Molhuysen	'The Operations of the British National Board for Prices and Incomes', to be published

Postgraduate Seminars, 1969

These Seminars are arranged to present the results of work-in-progress in the Unit and papers by outside researchers on topics of direct relevance to the Unit's research.

(*i*) *Spring Term* 1969

17 January	Prof S. Encel (*SPRU*)	'Science policy and the social sciences'
24 January	Mr A. D. McKnight (*SPRU*)	'The International Atomic Energy Agency safeguards machinery: a study (for UNITAR) on the verification of treaty obligations'
31 January	Mr G. Siddall (*Manager of the Technological Planning Unit of the Electrical Research Association*)	'Research and development by contract: a comparison of American and British practice'
7 February	Prof K. Hoselitz (*Deputy Director of Mullard Research Labs*) and Mr K. Benjamin (*Planning Manager of Plessey Radar Ltd*)	'Research management and project evaluation'
14 February	Mr D. M. Waddilove (*SPRU*)	'Education, technical manpower and economic performance: the LSE industrial manpower survey'
21 February	Prof E. I. Mendlesohn (*Collaborator on the Program on Technology and Society at Harvard University; Visiting Professor at Churchill College, Cambridge*)	'Problems of progress in the biomedical sciences'
28 February	Mr M. E. M. El Said (*SPRU*)	'International comparisons of national science policy-making bodies'
7 March	Mr K. Bibby (*British Iron and Steel Research Association*)	'Organisational aspects of innovation: a sociological approach'

14 March	Mr O. Gish and Drs M. J. A. de Maar (*SPRU*)	'The international migration of medical manpower: a "brain drain" case study'
21 March	Mr P. A. Shears, Mr R. M. N. Bell and Mr D. M. Waddilove (*SPRU*)	'Forecasting the effects on manpower requirements of technical changes in the engineering industry'

(*ii*) *Summer Term* 1969

2 May	Mr A. B. Robertson (*SPRU*)	'Success and failure of innovation in the scientific instruments industry: a paired case study'
9 May	Dr T. J. Allen (*Visiting Senior Lecturer at the Manchester Business School from the Sloan School of Management, MIT*)	'Communication patterns among engineers and scientists in industrial R and D laboratories'
23 May	Mr D. Sawers (*Economic Adviser to the Ministry of Technology*)	'The sources of invention'
30 May	Mr L. Reed (*Public Sector Research Unit*)	'Ocean space: in search of a stable and peaceable regime' (*joint seminar with the CCES*)
6 June	Dr S. Hirsch (*Leon Recanati Graduate School of Business Administration, Tel Aviv University*)	'Export performance of industrial firms in relation to skill intensity: a micro-economic view'
13 June	Mr S. Metcalfe (*University of Manchester*)	'The diffusion of innovations in the textile industry'

(*iii*) *Autumn Term* 1969

10 October	Mr R. M. N. Bell (*SPRU*)	'Science and development: a framework for analysis'
24 October	Mr C. M. Cooper (*SPRU*)	'National science and technology policy in developing countries'
21 November	Dr C. H. G. Oldham (*SPRU*)	'Science as a factor in aid: the Canadian case'

28 November	Dr H. Singer (*IDS*)	'Science, technology and international development'
5 December	Dr S. C. Hill (*SPRU*)	'A sociologist's view of science and development'

Conferences, 1968/69

Members of the Unit took part in science policy and other conferences as follows.

* *Indicates that a paper was presented by member(s) of the Unit* (*see under Papers and Publications, p.* 20)

1968		
12 November		Conservative Party Seminar on Science and Technology, London
2–6 December		OECD Conference on the Measurement of Research and Development, Frascati (Italy)
14–15 December	*	Conference on Social Science Policy, Loughborough University of Technology
18–20 December		OECD Seminar on Science and Development, Paris
1969		
27–31 January	*	ECE Meeting of Governmental Experts on Scientific and Technical Cooperation, Geneva
24–28 February		ECE Meeting of Governmental Experts on the Application of Modern Mathematical Methods and Computer Techniques to Economic Research, Geneva
15 March	*	Scotland-China Association Annual Meeting, Glasgow
28 March		Symposium on Safety and Siting, British Nuclear Energy Society, London
31 March–3 April		Conference on Regional Planning and Forecasting, organised by the Regional Studies Association, University of Sussex
11–13 April	*	Symposium on Technological Innovation and the Government of the National Economy, Science of Science Foundation, at Churchill College, Cambridge
15–16 April		OECD Conference on the Measurement of Scientific and Technical Information Services, Paris
15–18 April		International Conference on Computer Aided Design, organised by the Institution of Electronic and Radio Engineers and the Institution of Mechanical Engineers, University of Southampton
18–20 April	*	Canadian High School Students Conference on China, sponsored by the Canadian Institute of International Affairs at the University of Toronto
24 April	*	Safety Conference, British Oxygen Co, Waltham Cross

5 May		Conference on the Organisation and Management of Research and Development, Institute of Physics
7–10 May		Annual Conference of the Royal Society for the Prevention of Accidents, Scarborough
19–23 May		Conference on the Handling of Radiation Accidents, International Atomic Energy Agency, Vienna
2–6 June	*	Joint UNESCO/ECE Working Group on Science Statistics, Geneva
10–11 June		Conference on Futures in Urban Transportation, organised by the Marconi Co Ltd at the English Electric Staff College, Dunchurch
20–21 June	*	Conference on UK Aid Policy, J. D. Bernal Peace Library, London
27 June	*	National Science Council of Ireland, one-day Conference at Blessington
29 June–10 July		Crisis in Planning Conference at the Institute of Development Studies, University of Sussex
30 June–4 July		Fiftieth Anniversary Meeting on Industrial Safety, International Labour Office, Geneva
22 July		Conference on Medical Manpower and the Future, the Hospital Centre, London
18–23 August	*	Seventh Annual Conference on World Affairs: 'Imperatives for Development', Canadian Institute of International Affairs and the University of Alberta, at Banff, Alberta
27 August–1 September	*	UN Advisory Committee on the Application of Science and Technology, Working Group on the Role of Science and Technology in the Second Development Decade, Institute of Development Studies, University of Sussex
2–5 September		Conference on Safety and Failure of Components, organised by the Institution of Mechanical Engineers, at the University of Sussex
3–10 September		Annual Meeting of the British Association for the Advancement of Science, Plenary Session on Inventiveness and Innovation in Industry, Exeter
8–10 September		Meeting on the Analysis of Methodological Aspects of Social Studies related to Technological Development, Organisation of American States, Buenos Aires

9–10 September		Symposium on Technological Forecasting – Some Techniques, University Design and Innovation Group, sponsored by the European Technological Forecasting Association with the Design Research Society, University of Aston in Birmingham
16–17 September		Conference on European Technological Collaboration, Federal Trust for Education and Research, London
23–26 September	*	Board of Trade International Conference on Monopolies, Mergers and Restrictive Practices, Kings College, Cambridge
17 October	*	Institute of Development Studies Panel on Science and Technology in Aid and Development, The White House, Haywards Heath

Staff

Senior Research Fellows

C. Freeman BSc(Econ)(London) *Director*	Previous experience mainly in applied economic research and commercial market research. Led several research projects between 1959–68 at the NIESR and SPRU concerned with research and innovation, and has worked with the OECD on problems of R and D measurement.
C. H. G. Oldham BSc(Reading) MA PhD(Toronto)	Geophysicist with previous experience in the oil industry in North and South America and as Fellow of the Institute of Current World Affairs, studying science policy in several Asian countries. Responsible for Unit projects concerned with developing countries (see pp. 9–11).
R. C. Curnow BSc(London) ARCS	Mathematician and statistician with previous experience mainly in data processing and in R and D in industry. Previous Unit work on international trade in relation to R and D. Work this year on 'Project SAPPHO' (see p. 6) and on information systems (see p. 15).
A. B. Robertson BSc(Econ)(London)	Previous experience mainly in economic and management journalism, at the British Institute of Management, and at the NIESR on the chemical plant industry. Leading 'Project SAPPHO' (see p. 6).
J. A. Bennett BSc(London) AInstP	Physicist; formerly Head of Materials and Processes Group at the British Scientific Instruments Research Association. Leading Unit project on the Indian instruments industry (see p. 10).
P. A. Shears MA(Oxon) FIEE	Engineer/economist with experience in the electronics industry. Working on Unit project concerned with changing technology and the demand for manpower and training in the engineering industry (see p. 7).
T. C. Sinclair BSc(Edinburgh) AInstP	Physicist with experience in medical research. Formerly Senior Assistant Engineer in the Nuclear Health and

	Safety Dept, CEGB, working on aspects of safety in nuclear power stations. Leading project on human life and safety in relation to technical change (see p. 12).
C. M. Cooper BSc(Cape Town)	Economist and physicist. Previously at OECD Directorate for Scientific Affairs for six years working on the Pilot Teams Project on Scientific Research in OECD developing countries and on the Technological Gaps Project. Unit work on technology and trade in relation to developing countries (see p. 9).
A. J. Surrey BSc(Econ)(London)	Previous experience mainly at CEGB, NIESR and DEA concerned with the economics of the energy sector. Leading Unit project on international competitiveness in heavy electrical equipment (see p. 8).

Research Fellows

R. M. MacLeod AB(Harvard) PhD(Cantab)	Historian of science; Fulbright Scholar; Junior Research Fellow of Churchill College, Cambridge. Leading work on social history of science and project concerned with archives of scientists (see p. 13).
O. Gish BA(Brooklyn) MSS(The Hague) MPhil(Sussex)	Economist; MPhil thesis on the effects of medical migration on health manpower planning. Leading Unit project on medical migration (see pp. 10–11).
P. Jervis BSc(Sussex)	Physicist working on Unit projects concerned with scientific instruments (see pp. 6, 10 and 16).
R. M. N. Bell MA(Cantab)	Economist with previous experience in teaching and in research on corporate long-term planning. Working on Unit study of changing technology and the demand for manpower and training in the engineering industry (see p. 7), and on the generation and diffusion of innovations in developing countries (see p. 9).

Mrs. C. M. Tudway Ing E P F (Paris)	Engineer with previous experience mainly in surveys of R and D for the D G R S T and the O E C D in Paris. Unit work on 'Project S A P P H O' (see p. 6) until April 1969.
N. G. Clark B Sc M A (Edinburgh)	Economist/physicist; previously at the Economics Dept of Edinburgh University. Completing Ph D on the technological relationship between firms in the electronics industry and outside research bodies. Working on the Indian scientific instruments industry project (see p. 10).
D. M. Waddilove B A (Cantab)	Economist; previously with the L S E Unit for Economic and Statistical Studies in Higher Education, working on the industrial manpower project. Unit work on changing technology, manpower and training in the engineering industry (see p. 7). Joined the G L C Planning Dept in October 1969.
Miss M. J. A. de Maar Soc Drs (Rotterdam)	Sociologist with previous experience mainly in trade relations between Scandinavia and the Netherlands. Unit work concerned with medical migration (see pp. 10–11). Joined the Oslo Institute for Studies in Research and Higher Education in autumn 1969 to work on the migration of Norwegian doctors.
G. G. W. Moring B A M A (Sussex)	Economist; postgraduate work on industrial economics. Working on project concerned with human life and safety in relation to technical change. (see p. 12).
Miss G. C. Dean A B (Cornell) M A (Columbia)	Graduate in Asian Studies; postgraduate work on public law and government. Certificate of the East Asian Institute. Previous work for the U S Dept of State on Chinese studies. Unit work on Chinese science policy (see p. 9) and on bibliographic study (see p. 11).

S. C. Hill BSc(Sydney) PhD(Melbourne)	Physical chemist with postgraduate work in Melbourne University Business School. Previously lecturing in sociology, industrial engineering and management sciences at Northwestern University, Illinois. Unit work on the generation and diffusion of innovations in developing countries (see p. 9).
S. Barrio TD(Paris)	Economist and sociologist. Previously at the OECD Directorate for Scientific Affairs working on Technology Gap studies and on technological innovation. Unit work on trade and technology in relation to developing countries (see p. 9).
B. G. Achilladelis BSc(Alexandria) DPhil(Sussex)	Chemist with previous experience as Head of Production in the chemical industry and in the School of Molecular Sciences at Sussex working on biosynthesis of terpenes. Preparing MPhil thesis on innovation in the chemical industry. Unit work on 'Project SAPPHO' (see page 6).

Research Assistants

Mrs A. B. Berridge BA(Sussex)	Degree in international relations. Unit work on archives of scientists (see p. 13). Left SPRU in August 1969.
Miss S. L. Minden BA(Toronto)	Historian completing MA in the history of ideas. Working on Unit study of archives of scientists (see p. 13).
A. J. Leaman BA(Sussex)	Geographer working on project concerned with technical change, manpower and training in the engineering industry (see p. 7).
T. B. Smith BA(Sussex)	Geographer working on project concerned with technical change, manpower and training in the engineering industry (see p. 7).
Mrs L. L. Hill	Previous bibliographic experience in Australia and the USA. Working on project concerned with heavy electrical equipment (see p. 8).

Administrative Secretary

Mrs J. K. Fuller B A (Southampton)	Previous experience at N I E S R and S P R U on studies of research and innovation in industry.

Librarian

Mrs V. M. B. Craig-Mair	Previous experience at Royal Statistical Society Library, Institute of Petroleum Library and main Sussex University Library

Secretaries

Mrs A. P. Jervis (*General Office*)
Mrs M. O'Flaherty (*part-time*)
Miss D. F. P. Gibbs
Miss H. Groundsell

Visiting Professors and Fellows

S. Encel M A Ph D (Melbourne) (*August 1968–January 1969*)	Professor of Sociology at University of New South Wales. Previous work concerned mainly with problems of innovation, the nature of science policy and the role of social sciences in scientific education. Unit work on the social and political bases for national science policy, including ideological and historical aspects.
A. D. McKnight Ll B (Sydney) (*from November 1968*)	Lawyer; formerly Inspector-General of the International Atomic Energy Agency in Vienna. Work at Unit on principles involved in I A E A safeguards against military use of atomic energy, as a precedent for international verification of treaty obligations (see p. 16).
Mrs J. B. Lodahl B M (Wisconsin) (*August 1968–May 1969*)	Taking M S degree in organisational behaviour at Cornell University. Research on structure of U S university departments in the sciences.

M. E. M. El Said BSc (Alexandria) *(February 1967–June 1969)*	Chemist; Director of Natural Sciences Dept of the Supreme Council for Scientific Research of the U A R. Attached to S P R U initially on British Council Bursary and then on a U N E S C O Fellowship. Work on an international study of science policy-making bodies (see p. 16).
P. C. Molhuysen BEcon (Tasmania) M Econ (Adelaide) *(February–August 1969)*	Economist. Lecturer in economics at University of Tasmania. Work at Unit on the operations of the British Prices and Incomes Board.

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SCIENCE AND DEVELOPMENT

(STANFORD SYMPOSIUM, SEPTEMBER 1-4, 1970)

BACKGROUND

The Pugwash Symposium on "Science and Development" grew out of a recommendation made by working group V ("Modern Science and Developing Countries") of the 19th Pugwash Conference, held in Sochi (USSR) in 1969. This group felt that Pugwash should become more systematically concerned with problems of development, because the gap between the more and the less developed countries - MDC's and LDC's - is as much a threat to peace as is the arms race between two camps within the MDC's. [The group recommended the holding of a Symposium on this subject in the U.S. in conjunction with the 20th Pugwash Conference. Drs. Kenneth Hanson, Carl Djerassi, Eugene Rabinowitch, and Victor Rabinowitch were asked to organize this Symposium.]

In a statement circulated to potential participants in the Symposium, Dr. Eugene Rabinowitch explained more fully the reasons for a deepening involvement of Pugwash scientists in development. Scientists have long been encouraged to participate in the discussion of arms control problems, because of their recognized competence in this field. (Scientists have played a significant role in the development of new weapons, and have long served as government advisors in this area.) The need for involvement of people with the special training and knowledge of natural scientists has not been apparent at first in the field of development, since advancement of the LDC's appeared to be a problem of economics and politics, rather than of technology and science. However, the many disappointments en-

countered in attempts to raise the productivity of agriculture and industry in LDC's, have demonstrated that successful transfer of agricultural and industrial techniques depends heavily on adaptation of techniques to the needs of the country, and thuse on availability of properly trained personnel, both native and imported. This area is now becoming recognized as one of critical importance by international agencies concerned with development; and in it, scientists can provide significant assistance - both by activities within their own nations and by cooperative international efforts. The latter aspects of the situation are of special concern for the Pugwash movement.

Although problems of economic development have appeared on the agendas of all recent Pugwash meetings, and were the dominant topic of the conferences held in Udaipur (India) in 1964 and in Addis Abbaba (Ethiopia) in 1966, the Stanford Symposium was the first meeting of Pugwash scientists with development as its only subject. The participants,30 natural and social scientists from MDC's (18) and LDC's (12)*, met on September 1-4 at the Stern Hall at Stanford to consider the possibilities of a systematic activity of the Pugwash movement in this area. Representatives from UNESCO, UNDP, IDRC and NSF were present and took active part in the discussion.

AGENDA

In opening remarks, Dr. Djerassi greeted the participants and submitted the following tentative agenda for the conference:

1) Reports on present efforts of scientists from MDC's in the development field;

2) Contributions by scientists from LDC's: what they see as the main problems of development in their own countries, particularly from the point of view of possible assistance by scientists from MDC's.

* See addenda for sponsorship and list of participants.

3) Discussion of new ways in which the international scientific community and the Pugwash movement in particular, could contribute to development.

I. PRESENT EFFORTS OF SCIENTISTS IN DEVELOPMENT

A. Centers of Excellence in Research: The International Center for Insect Physiology and Ecology - (report by Thomas Odhiambo, Director of ICIPE, Nairobi, Kenya)

Dr. Odhiambo related the history of this "center of excellence"- a prime example of an attempt to build, from the ground up, the scientific capability of a group of LDC's.

In a statement made at the 17th Pugwash Conference, (Ronneby, Sweden, 1967) Dr. Djerassi proposed the creation of international "centers of excellence" in research, in fields of special relevance to certain underdeveloped areas. (This was the origin of the idea on which the Brazilian chemistry program, described below, was based.) Dr. Djerassi's article was published in the Bulletin of the Atomic Scientists.

In November of the same year, Dr. Odhiambo, an East African entomologist, published an article in Science in which he called for the establishment at Nairobi, Kenya of a "center of excellence" in insect physiology. A correspondence began, which ultimately lead to a meeting of a group of interested scientists, representing several academies, in Nairobi, at the invitation of the East African Academy of Science.

The interest of participants in this meeting lead to the decision to establish an Institute for Insect Physiology and Ecology at Nairobi, (ICIPE), with Dr. Odhiambo as director. Funds have been since raised for the first building, and the first postdoctoral fellow of this institute left the U. S. for Nairobi in Sept.1970. However, further funding remains

a major immediate problem, as there is no single source of funds to supply the about $1 million per year estimated as needed in the first five years of the program. It is hoped that in the long run, the institute will become largely self-sufficient through provision of services to governments and industries in East Africa.

B. U.S. National Academy of Science Programs - (report by Victor Rabinowitch, Office of the Foreign Secretary, NAS)

This report described the involvement of the National Academy of Science in Washington in development programs. Academy-sponsored Workshops, Symposia, and a number of meetings, brought together scientists from the U.S. with those from less developed areas. Major workshops were held in recent years in Brazil, Indonesia, Peru, the Philippines, and Taiwan, with additional meetings in other areas.

A major Academy project of this type is the Brazil Chemistry Program, which received its impetus from support by the Brazilian Research Council. In a five-year plan, a very high priority was set by the establishment, in Brazil, of two "centers of excellence" at existing universities, to train chemists at the doctoral level in specialized fields (synthetic polymer chemistry, organic chemistry, and advanced physical chemistry) which could have a major impact in areas such as agriculture, public health, and especially industrial research. With the aid and cooperation of the NAS, senior chemists in the United States agreed to supervise the work of postdoctoral fellows from their own institutions, to be carried out in Brazil. These young United States scientists will stay in Brazil on an average of two years, while conducting research with Brazilian graduate students and participating in course teaching at the doctoral level. There are, at present eight such postdoctoral fellows in Brazil out of the projected ten, with monetary support for this program being entirely Brazilian except for the stipends and travel expenses of the American Scientists.

C. The International Science Foundation - (report by Dr. Roger Revelle, Harvard University)

The ISF project is another result of interaction among scientists at Pugwash Conferences (the 14th at Venice, Italy, 1965, where the plan was first presented by Revelle: the 19th in Sochi, USSR, 1969, where it was elaborated). The purpose of the ISF would be to promote science research and science education in LDC's. Grants would be awarded to individuals or groups of scientists in LDC's, for research, preferentially of a nature relevant to the economic needs of the area in which it is to take place. The program has been approved in principle by the UN ECOSOC Committee on Science and Developments and by a conference of several national academies at Stockholm in June 1969.

The ISF is conceived as having the following specific aims:

1) Improving the teaching of science in developing countries through support of pure and applied research in universities and other schools.

2) Encouraging the creation of a nucleus of scientists who could initiate the establishment of "centers of excellence" in research, by supporting joint research proposals.

3) Providing opportunities for research to younger scientists, especially those engaged in research relevant to problems of development in their areas.

4) Improving the opportunities for cooperation between scientists in the developed and the underdeveloped areas.

There are many problems to be overcome before the ISF can be considered a viable organization - financial, national, social, and political. Attempts are now underway to enlist the assistance of national academies and of international organizations.

D. United Nations Development Program -(Dr. M. J. Kretzman, Deputy Director, UNDP.)

Since its establishment in January, 1966, all UN technical assistance has been channeled through UNDP. Two fundamental principles have been applied in granting this assistance:

1) Projects had to be requested by the country. (This guideline was modified recently to permit UNDP to undertake projects with global applications, e. g., increasing the protein content of corn.)

2) The recipient country was required to make an equal commitment of funds.

Beginning in early 1970's, the UNDP will stress regionalization and decentralization of administration. Regional offices, each directed by an assistant administrator, will be created for the following four regions: Mediterranean, South European, African, and Latin American/Asian. Direction of all projects will be decentralized to the developing countries, becoming an integral part of the country's own developmental program. The UNDP project director will be designated as "Resident Representative" and will reside in the participating country. It is hoped that these changes will allow the projects to be more closely integrated with the developmental programs underway in the developing countries.

E. Industrial Development Research Center -Dr. W. David Hopper, Director, IDRC, Ottawa, Canada.

The IDRC arose out of the need, expressed by the Canadian International Development Agency, for a research organization dealing with the problems of development.

Dr. Hopper explained that his report must be incomplete, due to the very recent establishment of the Center. As created by the Canadian Parliament, it will be a Crown Corporation managed by a Board of

Governors composed of eleven Canadians and ten non-Canadians (6 from developing countries in Latin America and Africa, 2 from Asia, and 1 each from the UK and the U.S.). The Board will have complete autonomy in the operation and management of the Center, its only restriction being its task of applying science and technology to the problems of development.

The first year's budget will be $2 million, with yearly increases during the first five years to an expected annual budget of $11 million in the fifth and subsequent years (this being approximately 5% of projected Canadian foreign aid budget). Seventy per cent of the appropriation will be used for "systems approaches" to developmental problems, with the remaining funds being used for exploratory research in all fields of science, conferences, scholarships, library operations, and etc.

Dr. Hopper reported that the IDRC will concentrate its emphasis on risk ventures which might not be well received elsewhere.

F. Ford and Rockefeller Agricultural Development Programs -(Dr. W. David Hopper, formerly associated with the Rockefeller Foundation.)

Dr. Hopper also reported on the Ford and Rockefeller programs, as the Rockefeller Fund representative expected to present the report was forced by a death in the Rockefeller Foundation leadership to cancel his participation.

This program began in 1960 jointly with the International Rice Institute in the Philippines. The Ford Foundation was to supply the initial capital, while the Rockefeller Foundation was to cover the annual running expenses. However, the operating budget of well over one million dollars was too much for the Rockefeller Foundation, and Ford agreed to pick up one half the costs, amounting to three-quarter million dollars.

Since the Institute proved to be so successful, three other agricultural research centers were either begun or taken over by these two cooperating foundations:

1) The International Center for Maize and Wheat Research in Mexico*

2) The International Center for Tropical Agriculture in Columbia, and

3) The International Institute of Tropical Agriculture in Nigeria.

Each of the three now has an annual budget of two and one half million dollars.

At the present, the World Bank is sponsoring a cooperative group which is planning to take over the financing of these four centers, and any similar agricultural research centers which might be founded, as the financial burden has proven to be too great for the two private foundations.

II. PAPERS BY SCIENTISTS FROM LDC'S

A. Dr. C. M. Varsavsky (Buenos Aires, Argentina)

Organization of Research in Developing Countries

Two major points were raised in this paper:

1) Few of the developing countries have governments which consider raising the standard of living of the majority of their citizens a matter of prime importance. Yet, without this concern by the government, the country will most likely not develop. It is, therefore, most important that major efforts be made to focus the attention of governments of LDC's on the problem. They must be induced to pose these two basic questions:

a) What goals do their country wish to achieve through development?

b) What actions are required to achieve these goals?

The first is a question of national values, which "outside" scientists cannot help to solve. The second is a question of methods and planning, in which the experience of scientists from other countries could be of help.

* The Director of this center, Dr. Borglund, received the 1970 Nobel Peace prize for his leadership in the development of high-yield wheat strains, now revolutionizing agriculture in many LDC's, particularly in S. Asia.

2) Scientists in LDC's must have a deep involvement in their country's development process. It is, therefore, most important that these scientists be "inward-oriented": that is, aware of their country's problems, and willing to undertake the research, pure and applied, which could aid in their solution.

Of these two points, the most susceptible to action by an international group of scientists such as Pugwash, is the one asking for change of value system taught to young scientists. The value of problem-oriented research must be stressed over that of research aimed on publication in international science journals.

B. Dr. F. G. Torto -(Faculty of Science, University of Ghana)

Some Problems of Development in African Countries

African LDC's suffer from many handicaps in their efforts to develop their own resources. These include: insufficient number of research personnel in all categories; scarcity of researchers in any one specialty which prevents the formation of research teams: lack of technical staff needed to assist research workers; inability of African administrators and scientists to apply research results in practice, largely caused by scarcity of organizations able to take over an invention and guide it to successful application.

The way to overcome these handicaps is to import experts from advanced countries. They should remain for a period of time sufficient to become familiar with the training of native scientists in research techniques. Application of research results to practical problems should be of prime concern to these experts.

C. Yash Pal (Tata Institute of Fundamental Research, Bombay, India)

Science and Development in India - Some Reflections

India's problems are rather different from those of most other LDC's.

There is already a rather strong research base in existence, with 70 national research laboratories, more than 70 universities, 20,000 colleges (with about 2 million students), and 450 technical and engineering schools. Approximately 300,000 graduates in natural science and engineering become available yearly for study of the country's problems.

Although all the ingredients seem to be present for rapid development of India's economic potential, masses of Indian people remain in poverty. The reason lies in social conditions rather than in lack of trained personnel. It is relatively easy to produce scientists and technologists, but the social patterns which would enable efficient utilization of the available skilled and non-skilled manpower, are not as easily produced. In addition, a large fraction of trained scientific personnel is insulated from the needs of the society, looking to Europe, the USSR, and the U.S. to determine what is "good" (that means "publishable") research.

D. Jose Barzelatto, OAS (Chile)

The Scientific Community and Latin American Development

The principal reason for Latin American underdevelopment is a weak scientific and technological infrastructure. The strengthening of this infrastructure should have the highest priority.

The only fields in which a proper system for administration and transfer of technology has been developed in Latin America, are medicine and agriculture. These are also the only fields in which national policies insured integration with national development programs. Only when an area of specialization receives strong government support causing a demand for scientists who can deal with the realities of the situation, do the trained personnel now existing in Latin American countries, turn to the needs of the country. Natural scientists, usually poorly paid, socially underesteemed, and dedicated to basic research, have been generally isolated, even indifferent to the concrete

needs of the society in which they live. It is only with government insistence and aid that the technological and applied research can be done, strengthening scientific infrastructure.

E. Dr. A. R. Abdel Meguid,(UAR)-Sr. Economist, World Bank (Washington, D.C.)
Economics and Technology of Development

Developmental economists rely on basic economic equations (such as "change in income is proportional to investment") without sufficient attention to dynamic relationships, catalytic agents, and logics which lie behind these equations. The neglect of the catalytic agents, in particular, required to make these equations valid, lies at the heart of the problems of developing countries.

In order to apply these equations(originally derived to express the relations existing in Western societies, and which do not adequately do even this), it is necessary to gather and analyze a mass of raw data describing the situation in a nation. Only after such analysis, would it be possible to prepare a comprehensive development plan and define the projects necessary to reach its objectives.

F. Dr. Antonio Bacigalupo -(Universidad Nacional Agraria, Peru)
An Approach to Knowledge, Development, and Peace

The gap between the technologically advanced and the developing countries is widening. Some of the reasons for the failure of the LDC's include malnutrition, ignorance, governmental indifference, and foreign exploitation. He pleaded for the universal acceptance of the declaration of human rights for every person and utilization of science and technology for the good of all mankind.

The developed nations should turn their attention to fostering economic and social development in the LDC's. Effective technical assistance program

requires a combination of scientists, economists, philosophers, sociologists and politicians. Developed nations should be tolerant of the trial and error method of developing nations in their search for better systems and plans, as different situations require different solutions.

G. Dr. James Coleman -(Insitute for Development Studies, University College, Nairobi, Kenya)- "The Need for Social Scientists"

Social scientists are badly needed in Africa. The social research actually undertaken is done by foreigners who gather the data they need and leave the country. Only when social scientists are native to the area, will serious social research get under way, resulting in collection of data necessary for adequate planning for the development of an area's potential. Developed countries should help African universities to train cadres of social scientists. African degree-granting institutions should work out the requirements for social science specialization with a minimum of external advice, while the training of scientists could be supported in large part by the MDC's.

H. Dr. John Katili -(Indonesian Institute of Science)

The Role of Science and Technology in the Development of Indonesia

Indonesia's population is increasing rapidly, outstripping the food and agricultural output of the nation. There is much resistance to change, and unwillingness to accept new ideas impedes development. Lack of transportation and communication between the islands is a great obstacle to planning and research. Research efforts also suffer from political and financial instability, the absence of scientists studying abroad, too many research projects, low salary scales for scientists, absence of document handling and disseminations systems, and the list continued.

The following five areas must have the highest priority for the developmental program in Indonesia:

1) Tropical biology, especially as pertaining to agriculture,

2) Geology and mineral exploration,

3) Natural resource surveys,

4) Standards setting, testing and quality control, and

5) Documentation and information dissemination.

III. GENERAL DISCUSSION

A lively general discussion followed the presentations, of which only a few points can be mentioned here.

Dr. Oldham (UK) described the studies undertaken at the Science Policy Research Unit at Sussex University, with special reference to conclusions concerning the distribution of research and development funds. The LDC's support only two per cent of world-wide R. and D.: of the other 98 per cent, only 10 per cent (or less) can be in any way useful for the solution of the problems faced by LDC's.

Drs. Abdul Meguid (UAR) and Kretzman (U.S., UNDP) suggested the development in MDC 's, of new university curricula, on the graduate level, for those intending to work on the problems of poor nations.

Dr. Diczfalusy (Sweden) described the activities of the Karolinska Institute in Stockholm, in cooperation with the World Health Organization in Geneva, on the problems of population control in developing countries. Dr. Djerassi (Stanford) pointed out that birth control methods that are "simple" in one society, might not be so in another, so that research into societal taboos and other social problems is required before long-range population control planning can be undertaken in these areas.

Dr.Glubrecht (FGR) reported on the Pugwash "Protein Symposium" held at Oberursel in 1970. He mentioned the foundation of a German "Institute for

Study of Living Conditions in the Technological World."

Dr. Hanson (Stanford) analyzed two basic means for correcting the lop-sided distribution of scientific infrastructure, the growth of scientific capabilities in the LDC's, and mobilization of scientists from the MDC's.

Dr. Buzzatti - Traverso (Italy, UNESCO) presented the draft of an appeal written by him, together with Dr. Abdus Salam (Pakistan) directed to world scientists and calling for organization of an international "Association of Scientists for Development." This suggestion was supported by participants in the Symposium, but it was suggested that the planned Association should not be tied specifically to the International Science Foundation (as implied in the draft).

Dr. Parthasarathi (India) suggested that Pugwash should serve as an international scientific "Lobby" for development.

Dr. Bacigalupo (Peru) asked whether "surplus" scientists in MDC's could not be made available for science development in LDC's.

Dr. Diczfalusy (Sweden) suggested that meetings should be arranged between Pugwash-based groups and specialized UN agencies.

Dr. Nash (Chicago) observed that present concern of the Northern "center" with economic, social, cultural, and scientific welfare of the Southern "periphery" (as evidenced by the Stanford meeting) is a phenomenon not observed prior to the 20th centry. This concern is important for the development of the LDC's, and should be nurtured by scientists from both the LDC's and the MDC's.

Dr. Varsavsky (Argentina) expressed the belief that perhaps the most important objective for the present, is to find a definition of "development" that will prove acceptable to the areas and people being "developed": he suggested a research project on "what constitutes happiness".

Dr. Pathasarathi (India) objected to the assumption that developing nations are occupying different positions along a universal development curve. This is true if only the GNP is considered; but each culture is shaped by different social, economic, and spiritual forces. Struggles for social and political change, needed for economic development, are an internal problem of these cultures. It would be illegitimate for scientists from abroad to act as "subversives" in this struggle, as suggested by Dr. Hanson. Scientists in developed countries should work instead on their own power structures - governments, industry, military - to persuade them to adopt a more cooperative approach to technical aid. Scientists must choose between being members of their own culture first, and being primarily members of the international scientific community.

It had been suggested that Pugwash can help in achieving East-West cooperation in assistance to the "South". This is not original - diplomacy can do that. Scientists should see cooperation in development in a different light. It should be cooperation involving above all the "South" itself; a "South-South" cooperation, with the participation of the North - not North-North cooperation with the South as "recipient".

Importance of cooperative, regional studies and activities was pointed out by several participants. Dr. Pal (India) mentioned the problem of cyclones in the Indian Ocean area as one problem of common conern to several states.

The importance of social change for technical economic development was emphasized by many participants. Technological change can substitute for social change, but only to a limited extent.

Dr. Marcovich (Institut Pasteur, Paris, France) submitted a paper prepared in cooperation with Dr. I. Sachs: "The Methodology of Foreign Aid to Less Developed Countries (LDC) with Special Reference to Science and Technology": It suggested that all present forms of aid or technical assistance to the less developed countries are liable to suspicions. The motives of the donors range from charity - moral compulsion to aid the poor - to guilt-complex, urging them to redress the wrongs of the colonial past, and "pondered desire of reducing dangerous tensions." Most recipients accept aid in the belief that "some help is better than none"; at times, personal advantages gained by the recipient country's political leaders are all that keeps the aid programs going. "...Gloom and disenchantment prevails by now, even among people who once believed in the possibility for world-wide international cooperation in development." "The decision-makers in the LDC's having been educated in the rich countries, react and behave like foreigners from the donor country", "it might be difficult for them, if not impossible, to behave according to the best interest of their country."

If present aid from the "rich countries" is suspect, what can be done to make it"genuine?" The following five characteristics were suggested:

Aid should add to the country's development potential, i.e., expand the productive capability, strengthen the intellectual community able to assist the productive structure, and help in developing a political and administrative machinery geared to independent decision-making.

Choice of the forms of aid should be left to the recipient country.

The recipient country should have the right to learn by making mistakes on its own priorities, facilities, etc.

The time period of the aid program should be limited, after which the terms should be renegotiated.

Aid should be provided through multilateral channels (through modified UN machinery, if possible).

IV. RECOMMENDATIONS

During the discussions, many suggestions were brought forward as to what Pugwash might try to achieve in the field of development. These suggestions included:

a) Sponsor conferences and symposia, particularly "traveling symposia", convening in different LDC's to discuss topics of particular importance to an area.

b) Establish institutions, lobbying groups, and clearing houses.

c) Undertake service functions, especially in the field of communications .

A specific recommendation of the Symposium to the Pugwash Continuing Committee was to establish a Standing Research Group to develop Pugwash program in Science and Development.

This recommendation was endorsed by working group IV at the 20th Pugwash Conference at Fontana (Wisconsin) and approved by the Pugwash Continuing Committee.

CONCLUDING REMARKS

Dr. Roger Revelle emphasized, in a closing speech, that Pugwash is an unofficial channel of communications between the scientific communities and the political decision-makers. Its effectiveness depends on its ability to remain independent and unaffected by pressure groups, and to retain an unbiased scientific approach to problems. Whatever the actions to be undertaken, this must be the context within which it will act.

Stanford Conference

ADDENDUM 1 - SPONSORSHIP

The Stanford Symposium was sponsored by the U.S. Pugwash Committee (affiliated with the Ameircan Academy of Arts and Sciences in Boston) and co-sponsored by the Center for the Study of Science and Society at SUNY - Albany. The Center contributed to the preparation of the Symposium by donating the services of Mr. Warren Hall, Assistant to the Director, before and during the Symposium, and accepting responsibility for travel of U.S. participants. Hospitality in Stanford was provided by three foundations* at Stanford, which also funded the travel of several oversea participants and contributed the services of Dr. N. Vietmeyer as Administrator. The Asia Foundation at San Francisco supported the travel of three Asian participants.

The Center at SUNY is exploring the possibility of a book based on elaboration of a number of presentations and discussion remarks at the Symposium.

The American Academy of Arts and Sciences at Boston help the Symposium by allowing Mrs. Ruth Adams and its secretarial staff, to spend considerable time in preparing the list of invitees and organizing their travel.

ADDENDUM II - PARTICIPANTS IN THE STANFORD SYMPOSIUM

5	ASIA:	J. Pal; Parthasarathi (India); Katile(Indonesia) Chaudhuri (India); Okita(Japan)
4	AFRICA:	Torto(Ghana); Odhiambo, Coleman (Kenya); Abdel Meguid(UAR)
4	S. AMERICA:	Baciagalupo (Peru); Barzelatto (Chile); Leon (Columbia); Varsavsky(Argentina)
6	EUROPE:	DeWilde (Holland); Diczfalusy(Sweden); Glubrecht (FDR) Marcovich (France); Oldham, Rotblat (UK)
13	US AND CANADA:	Adams, Djerassi, Engel, Franck, Hanson, Hirschman, Hopper,(IDRC) Kirk, Nash, E. Rabinowitch, V. Rabinowitch, Revelle, Sohns,(NSF)

* Syntax Corporation, Zefferoni Foundation and Hewlett Foundation

Stanford Conference

ADDENDUM II - continued

STUDENTS: Bloch, Gebreyesus, Hall

INTERNATIONAL ORGANIZATIONS: Buzzati-Traverso (UNESCO); Kretzmann (UNDP)

ADDENDUM III - PUGWASH STUDY GROUP ON DEVELOPMENT

The provisional composition of the Study Group is:

Africa	Dr. F. G. Torto (Ghana)
Asia	Dr. A. Parathasarathi (India) : Dr. J. Katilil (Indonesia)
S. America	Dr. C. Varsavsky (Argentina)
Europe	Dr. C. H. Oldham (G. B.): Dr. B. Laponche (France)
United States	Dr. V. Rabinowitch (Convener)
USSR	Dr. I. Mozheyko, Academy of Sciences Institute for East Asian Studies

This group plans to hold its first meeting at the UNESCO building in Paris in April 1971.

Chips

Dr. Szilard is expecting a call - she will be in Twain North dining room — she has on a pale orange dress and grey hair in a bun and glasses.