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ABSTRACT

A global seminar on the role of scientific and engineering societies in development, held in New Delhi, India, in 1980, had as its objectives: (1) to document prior successful, and unsuccessful, activities of scientific and engineering societies in furthering development; (2) to identify and discuss the types of activities to which scientific and engineering societies can uniquely contribute with the intent to further development; (3) to enumerate and describe specific cooperative projects; and (4) to follow through with the planning of a few high priority programs. (PB)

Report on the

Global Seminar on The Role of Scientific & Engineering Societies in Development

New Delhi, December 1 - 5, 1980

Organised by

American Association for the Advancement of Science, Washington, D.C.

Indian National Science Academy, New Delhi

Indian Science Congress Association, Calcutta

AAAS • INSA • ISCA

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A SMALL HYMN TO SCIENCE

The ethic of science
Puts total reliance
On love of surprise
And on not telling lies

It has no animosity
Towards curiosity
And greatly admires
The mind that inquires

It always regrets
The employment of threats
Whenever they're made
In attempts to persuade

For the world cannot fail
To tell its own tale
When questioned aright
In a rational light

So we don't have to quote
By letter or rote
The words of the sages
Of previous ages

For the real world itself
Is our library shelf
And ideas are best
When put to this test

Then how do we choose
The knowledge to use
In improving the state
Of folks small and great?

It is clear we must call
On scientists all
To follow their light
With all of their might

And get each Society
To see the propriety
Of opening their door
To the needs of the poor

And expand knowledge which
Can help to make rich
Can control human strife
And improve human life

Kenneth E Boulding

CONCLUSION AND RECOMMENDATIONS : SUMMARY

It is in the interest of all scientists and engineers to encourage development. This Seminar makes the following recommendations:

(i) Scientific and Engineering Societies should play a more active role in development and should be strengthened for that purpose when and where necessary.

(ii) Planning and evaluation for development purposes should be increasingly addressed by scientific and engineering societies as part of their activities.

(iii) Societies should expand and emphasize their contribution to the education and training of scientists, engineers and technicians for solving development problems.

(iv) The ability of scientific and engineering societies to collect, evaluate and communicate information should be more strongly focussed towards development.

(v) The U.N., National Governments, private foundations and societies should together develop plans and funding mechanisms for bringing scientific and engineering societies into development projects where practicable.

(vi) The momentum created by the Seminar should be maintained and a Steering Committee chosen from the participants to coordinate follow on actions.

AGENDA

December 1

2.30 pm — CONVOCATION AND INAUGURAL REMARKS

Professor A K SHARMA
Seminar Chairman

Professor K E BOULDING
Seminar Co-Chairman

Professor V RAMALINGASWAMI
President, INSA

Professor M G K MENON
Secretary, Dept. of Science and Technology, Govt. of India

Mr E Q DADDARIO
American Association for the Advancement of Science

Dr T F MALONE
U S National Academy of Sciences

Dr R LALKAKA
Deputy Director, Interim Fund for Science and Technology for Development, United Nations Development Programme

4.00 pm–5.00 pm — OBSERVATIONS REGARDING STRUCTURE OF THE SEMINAR; ANNOUNCEMENTS; CHARGE TO THE WORKING GROUPS

Dr S K DASGUPTA *(ISCA)*

Dr J N NANDA *(INSA)*

Dr J T RATCHFORD *(AAAS)*

5.00 pm — Adjourn

Evening — Dinner *(by President, INSA)*

December 2

9.30 am-11.00 am — PLENARY SESSION

Chairman: Professor K E BOULDING

Addresses:

Engineering Sciences
Mr J DEBELIUS
Deutscher Verband Technisch-Wissen-schaftlicher Vereine

Social Sciences
Professor K E BOULDING

Natural Sciences
Dr Y NAYUDAMMA
Chairman, Committee on Science and Technology in Developing Countries

11.30 am-1.00 pm — Discussion

Discussion Leader:
Dr M S SWAMINATHAN
Member, Planning Commission, Govt. of India

1.00 pm-2.30 pm — Working Lunch

2.30 pm-5.00 pm — Working Groups to meet concurrently

1. Applied Research and Development
2. Scientific and Technological Information
3. Scientific and Technological Education and Training
4. Scientific and Technological Planning and Evaluation

December 3

9.30 am-1.00 pm — Working Groups

1.00 pm-2.30 pm — Working Lunch

2.30 pm-4.30 pm — Working Groups

5.30 pm-6.30 pm — Reception *(by Chairman, AAAS-Chairman of the Board)*

December 4

9.30 am-1.00 pm	Preparation and finalization of respective reports/recommendations by each working group
10.0 pm-2.30 pm	working Lunch
2.30 pm-5.00 pm	PLENARY SESSION *Chairman:* Professor K E BOULDING Presentation of summaries of working group discussions by Rapporteurs, followed by a presentation of each group's recommendations by working group Chairmen, and Discussion.
5.30 pm-6.30 pm	Reception *(by President, INSA)*
8.00 am-10.00 pm	Meeting of drafting committee to prepare final consolidated report of the seminar

December 5

9.00 am-10.00 am	Meeting of all Workshop Chairmen and Rapporteurs to discuss final consolidated report of the Seminar
10.00 am-11.00 am	PLENARY SESSION *Chairman:* Professor A K SHARMA Presentation of Draft Report/Discussion
12.00-1.00 pm	CONCLUDING SESSION *Chairman*: Professor A K SHARMA Presentation of Final Report Recommendations Closing Remarks
6.00 pm	Cultural Program and Dinner *(by President, ISCA)*

CONTENTS

INTRODUCTION

The American Association for the Advancement of Science (AAAS), the Indian Science Congress Association (ISCA), and the Indian National Science Academy (INSA) jointly organized this global seminar on "The role of Scientific and Engineering Societies in Development". The seminar was held in New Delhi, India, December 1–5, 1980, at the India International Centre. Over 100 participants representing the leadership of mainstream scientific and engineering societies from all parts of the world carefully examined the development process and recommended unique contributions which the scientific and engineering societies can make in fostering national development.

1.0 Background

This seminar was one of a series of various activities undertaken by AAAS, ISCA, and INSA which relate science and technology to national development. These included specific projects related to preparations for the UN Conference on Science and Technology for Development (UNCSTD), held in Vienna during August, 1979.

1.1 1978 Joint Indo-US Seminar

The Asian Regional Seminar on the Contributions of Science and Technology to National Development, held in New Delhi during October 4–6, 1978, was one in the series of meetings convened by Non-Governmental Organizations (NGO's) in preparation for UNCSTD. The seminar was jointly planned and organized by AAAS, ISCA and INSA. The 1978 seminar, partly funded by the US National Science Foundation (NSF) and the Department of Science and Technology, Government of India, provided a forum for discussion and debate among US and Asian scientists on substantive issues related to the development of autonomous capacity to utilize science and technology as resources to achieve national development goals. Further, the seminar aimed at increasing communication between US scientists and their colleagues in India and other countries of Asia, as well as increasing Asian regional cooperation. The Report and Proceedings were valuable to many countries in preparing for UNCSTD.

1.2 1979 AAAS-UNCSTD Workshops

AAAS held a series of four workshops under sponsorship of the US Department of State, as part of US preparations for UNCSTD. Of particular relevance to the proposed seminar were the following two workshops:

1.2.1 *Building National Institutions for Science and Technology in Developing Countries*, held on April 18–19, 1979.

The participants stressed the need to strengthen and improve present institutions rather than create new ones. Recommendations included the following points:

(i) Developing countries should set their own goals and these should be respected by the countries

(ii) An Institute of Scientific and Technological Cooperation (ISTC) should be established in the US

(iii) US cooperation should be based to a substantial degree on non-governmental and quasi-governmental organizations

(iv) The US should expand scientific and engineering manpower development efforts

(v) Efforts to improve the flow of information should be directed towards solving problems rather than to implementing a large, general purpose automated information storage and retrieval system.

1.2.2 *The Role of Scientific and Engineering Societies in Development*, held on May 21–22, 1979

The dominant theme of this workshop was that scientific and engineering societies have certain basic characteristics which enable them to make unique contributions to the development process in any country; they constitute a reservoir of individual scientists, engineers, and technicians with special knowledge and expertise that can be mobilized to undertake specific tasks; they provide a peer review capability for evaluating the importance and value of scientific and engineering proposals, programmes, and accomplishments; they contribute state-of-the-art reviews of advances in their own disciplines; they constitute an open market for technology planning and delivery, not constrained by institutional proprietary, or political barriers; and they provide a useful teaching and educational function through the journals, reviews, handbooks, and books that they publish on accomplishments and advances in their disciplines.

It was concluded that US societies can assist in the development of a strong system of scientific and technological education by nurturing the formation and growth of indigenous scientific and technical societies, developing relationships with universities to give leadership in their disciplines toward more relevant training for foreign students, and giving attention and peer approval to professional participation in international development work.

2.0 Objectives of the Global Seminar

Professional societies are an important part of the scientific and engineering infrastructure of most countries. The problems posed by development are generally multidisciplinary in nature and often international in scope. The collaboration of scientists and engineers and of the societies to which they belong can be an important factor as developing countries build their own capacities for basic and applied research, and the related infrastructure needed to help solve national problems.

Partnerships between societies from industrialized and developing countries, equally entered into on the basis of mutual respect and cooperation, can be beneficial to the advancement of the intellectual and social goals of both industrialized and developing societies. The unique characteristics of the scientific and engineering societies have permitted them to make contributions to science and its applications to development problems, and UNCSTD has created a momentum on which to build for the future.

The seminar sought to:

(i) present the current thinking of various societies regarding their own contributions to development

(ii) identify the factors involved in development and those aspects of the process that are appropriate for the scientific and engineering societies

(iii) provide participants with facts documenting past, current, and planned activities of the societies

(iv) energize those societies not yet involved in development to follow suit and initiate efforts appropriate to the goals and resources of their organizations.

The specific objectives of the seminar were:

A. To document prior successful—and unsuccessful—activities of scientific and engineering societies in furthering development

Using the results of the workshop on the Role of Scientific and Engineering Societies in Development as a starting point, participants sought to assess how the unique capabilities of the societies have been utilized in the past. Activities to further basic research, facilitate communication and cooperation among scientists and engineers, and improve the effectiveness of science and technology as they are applied to solving development problems were reviewed.

B. To identify and discuss the types of activities scientific and engineering societies can uniquely perform or contribute to, with the intent to further development

Based upon past experience, the participants attempted to clearly define those activities that societies from both industrialized and developing countries can perform to help solve development problems. The May 1979

Washington workshop identified some of the things the US societies could do. This seminar brought the discussion to an international, even global scale, so that scientists and engineers from other industrialized countries and the developing areas were able to discuss these ideas and initiate others.

C. To enumerate and describe specific cooperative projects

Discussions of past activities and present undertakings and plans that are expected to bear fruit served as a central focus. A few participating societies described in detail possible cooperative projects to be undertaken to fulfill the goals mentioned above.

D. To follow through with the planning of a few high priority projects

Based on the deliberations of the seminar, a few specific projects will be identified for further study and definition. Planning will take place during the months following the seminar. At least one project will be based in India.

Examples of such joint projects are provided by the efforts of the American Chemical Society (ACS) with its counterpart societies both in Egypt and India. The Indian Chemical Society and ACS held a seminar in January 1980 to review major recent trends in research in the two countries in various chemical sub-fields, and plan cooperative research projects in those sub-fields. This demonstrates that professional societies can participate in the development of research capabilities by undertaking joint projects after holding joint workshops.

These objectives went beyond those of the May 1979 AAAS workshop, the results of which were only a starting point for the global seminar. The discussions were expanded to a perspective truly international in scope. Further, the momentum generated will be utilized to assess possible follow-on steps and initiate the planning of a few pilot projects.

Throughout the seminar, discussion was oriented towards the process by which scientific and engineering societies can address development problems. The discussion of specific problems (e.g., food, energy, communications, etc.) was encouraged for illustrative purposes only.

3.0 Organization of the Global Seminar

3.1 Planning

The responsibility for planning the seminar rested with the principal cosponsoring-organizations (AAAS, ISCA, and INSA).

A Joint Organizing Committee of US and Indian scientists and engineers provided advice and counsel at all stages of the organization of the seminar. The committee advised on the participants, planned the agenda, oversaw the logistical arrangements, and will assist in the selection and planning of follow-through activities.

The AAAS Consortium of Affiliates for International Programmes served as a major resource to nominate and help to select participants from the US, and identify potential participating societies and individuals from other countries.

The Consortium consists of approximately 80 of the scientific and engineering societies affiliated with AAAS. It was formed in 1976 to facilitate communication among those scientific and engineering societies which have expressed interest in the international aspects of their disciplines; to stimulate joint programmatic activities and cooperative programmes through the establishment of a broadbased multidisciplinary network of associations; and to raise the concerns of scientific and engineering associations regarding international science policies and priorities.

3.2 Background Material

Background materials provided to participants of global seminar included the following:

1. Copies of invited and contributed papers
2. The Report of the Asian Regional Seminar on "The Contributions of Science and Technology to National Development", held in New Delhi, October 6–8, 1978
3. The Proceeding of the AAAS workshop on "Building National Institutions for Science and Technology in Developing Countries", held on April 18–19, 1979
4. The Proceedings of the AAAS workshop on "The Role of Scientific and Engineering Societies in Development", held on May 21–22, 1979
5. The Report on the International Symposium on "Science and Technology for Development", held in Singapore, January 22–26, 1979

4.0 Participants

4.1 Number

The number of participants was set at approximately 100, the minimum deemed capable of providing geographic diversity among the various societies and the potential for a truly global dialogue. At the same time, it was small enough to be manageable and produce tangible results through work accomplished in small groups.

The participants were mainly scientists and engineers, representing a broad spectrum of scientific and engineering societies. They represented disciplinary societies from the natural sciences, social sciences, and engineering, and came from both developed and developing countries. Participants from developing countries were in some cases leading scientists or engineers but not necessarily disciplinary society representatives, especially where such societies are not yet firmly established. Thirty-five countries were represented. The largest delegations came from India, the US, the USSR and the People's Republic of China.

4.2 *Selection*

4.2.1 *Criteria*

The pool of eligible societies included non-governmental, disciplinary, multi-disciplinary and federative scientific and engineering societies and associations of national stature.

Participants had either demonstrated by their activities a strong commitment to development, or expressed an interest in becoming active in development. That interest, combined with a position of leadership within a society, aimed to encourage the commitment of a larger number of societies to participate in development activities. The Joint Organizing Committee felt that endorsement by the leadership of a large number of societies would help assure a higher quality of scientific and engineering talent being devoted to development problems in both industrialized and developing countries.

4.2.2 *Nominations and Selection*

Nomination and selection of potential participants from Asia were the primary responsibility of INSA and ISCA with the counsel of the Joint Organizing Committee. The advice of recognized and established scientific and engineering societies in India was sought in the selection of Indian participants.

Nomination and selection of potential participants from the rest of the world was the primary responsibility of AAAS with the counsel of the Joint Organizing Committee, in consultation with its Consortium of Affiliates for International Programmes.

In all cases indigenous scientific and engineering societies were consulted to the maximum extent possible.

5.0 The Seminar

The Seminar was held in New Delhi, at the India International Centre. The agenda is found on pages xi–xiii of this publication. The co-chairmen were Professor AK Sharma (ISCA) and Professor Kenneth E Boulding (AAAS). The language of the seminar was English.

5.1 *Working Groups*

Participants devoted most of their time to discussions in working groups, where they analyzed the specific roles scientific and engineering societies can play in each of the following areas:

5.1.1 *Applied Research and Development:* The organization of projects and the assembly of R & D teams capable of providing solutions to important problems, at least through the initial stages.

The Applied Research and Development working group covered the formulation of applied research projects of common relevance to both industrialized and developing countries. It addressed means to harness the

expertise available in different institutions to develop desirable technologies while optimizing available facilities and expertise. Relations between research institutions and those involved in production, such as private and state enterprises, especially small-scale enterprises, were considered. Other topics included ways of articulating and formulating societal and economic needs for the guidance of those involved in directing and performing research and development; and development systems for assessing the effectiveness of research and development programmes; and natural resource evaluation and utilization projects.

5.1.2 *Scientific and Technological Information:* The generation, dissemination, abstracting, indexing, retrieval and popularization of scientific and technical information

This working group discussed the characteristic modes of information transfer: personal, print and electronic, as well as the motivations and incentives for the utilization of the best technological information in development-related activities. The relationships between primary technical information sources and secondary sources, including trade journals, consulting firms, and technical standards, were considered, as well as relationships between scientific and technological information systems and other bibliographic data bases and networks, especially international networks. The role of scientific and engineering societies in reviewing, condensing, evaluating, packaging, and popularizing scientific and technological information for various types of users received special emphasis.

5.1.3 *Scientific and Technological Education and Training:* The processes and the criteria for the selection of students and teachers, the design, contents and development of curricula, the building of faculties and institutions, and integration of students into work and life, and continuing education and training

Integration of scientific culture with surrounding indigenous culture and traditions was considered in this working group, including the impacts of scientific training in alienating students from traditional cultures. The role of scientific and engineering societies in developing model curricula or restructuring existing curricula to adapt best to the development needs of a country was discussed; this included the accrediting of academic study programmes and the setting of conditions for entrance into a scientific or engineering profession. Adverse restrictive effects (overly protective rules that restricted entry or created professional monopolies) as well as benefits of actions by the scientific and engineering societies were considered. Other topics included the active participation of students and teachers in societal development through educational extension activities such as adult and continuing education, national service, and application of science and technology to local needs.

5.1.4 *Science and Technology Planning and Evaluation:* The identification of priority problems and the possible technologies to solve them, the process of selecting those most appropriate and most likely to succeed, and the role of policy research aimed at linking science and technology with the social, economic, and political system at the local, national or regional level.

This working group discussed problems of local, national, regional and global relevance which have their roots in science and technology or are particularly amenable to scientific and technological solutions. Coordination of those problems with the policies of individual countries and of world organizations, and the establishment of priorities in relation to national needs were considered. The process of selection and assessment of the most appropriate technologies to solve specific problems, taking into account factors of economic efficiency, manpower and material resources, and socio-cultural background was analyzed. The group considered the meaning of development as realization of the human potential, explicitly taking into account non-economic issues relating to the quality of life and which are incorporated into traditions of personal freedom and indigenous political and cultural institutions.

6.0 Follow-through Activities

Planning of a few follow-on projects is an important objective of the seminar, and was the subject of the final session of the Joint Organizing Committee held immediately after the close of the seminar. Project formulation will be carried out by small groups of experts. These meetings will be convened over a period of time, and will start with preplanning of specific projects. These projects will be expected to show how the general principles discussed at the seminar can be directly applied to meet specific needs.

Funding for each follow-on project (beyond the preplanning/feasibility evaluation stage) will be sought separately by the disciplinary societies concerned from appropriate national or international agencies. At least one demonstration project should be based in India and lead to long-term cooperation between relevant societies in developed countries and Indian societies and other institutions.

CONCLUSIONS AND RECOMMENDATIONS

It is in the interest of all scientists and engineers to encourage development. With this preamble, the participants unanimously adopted the following conclusions and recommendations of the Global Seminar on "The Role of Scientific and Engineering Societies in Development". These conclusions and recommendations express in a tangible way the need for scientists and engineers to look beyond their own narrow disciplines towards the application of their institutional capabilities to attain the broad goals of national development.

The Seminar's conclusions and recommendations are the result of discussions that occurred in the plenary sessions and four working groups. In those working groups, the participants spent most of their time discussing and identifying the unique characteristics of the scientific and engineering societies in diverse economic and political structures, and considering how the societies could help solve problems of development in four areas: (1) applied research and development, (2) scientific and technological information, (3) scientific and technological education and training, and (4) scientific and technical planning and evaluation. Each working group presented its own report, including a set of specific recommendations. The four reports are an integral part of this volume.

There are six major conclusions and recommendations. Related to each are specific points from the four working group reports. The six major conclusions and recommendations, together with all the subsidiary points, were presented to the final plenary session of the seminar and unanimously approved. In their ensemble they represent what the participants came to refer to as "the spirit of New Delhi", heralding a new era of participation in development initiatives by the national disciplinary scientific and engineering societies, with cooperation between East and West as well as between North and South.

I. *Because of their unique characteristics, scientific and engineering societies should play a more active role in development and should be strengthened for that purpose when and where neeessary.*

Specifically these societies are a reservoir of specialized scientists and engineers which can be mobilized for special tasks; they provide a peer review system when needed; they can become an infrastructure for planning and evaluation without institutional, proprietary or political constraints; their publications of various kinds can furnish the needed information for development; they can serve as a forum for information exchanges. Industrialized countries have strong scientific and engineering societies which in general, have not addressed problems of development as they should.

In developing countries, disciplinary societies are often weak or non-existent; their creation should be encouraged with strong support from societies in industrialized countries.

In the case of the least developed countries, regional societies may initially carry out the needed task, keeping in view the necessity of eventually establishing national societies.

In any case partnerships between societies from industrialized countries and developing countries, as well as among societies in industrialized countries should be encouraged and increased.

Specific Recommendations

To achieve the goal started above, several actions are required, to be undertaken by societies as follows:

A. Groups of societies in industrialized countries, with the collaboration of societies and other appropriate organizations from developing countries should:

1. Compile a World Directory of Scientific and Engineering Societies. To facilitate copperation among scientific and engineering societies, it is highly desirable to have a world-wide Directory of Scientific and Engineering Societies. This directory would be classified into major fields and disciplines; cross-indexed under country, region, etc., and contain descriptive information on each society. The directory should be revised and updated periodically, annually if possible, and the actual compilation should be performed by a society or a group of societies possessing the facilities, manpower, and experience to implement this project under the overall supervision of an international steering committee.

2. Compile and continually update a roster of individuals and societies by discipline who are expert in and have interest in problems of development. Such a roster should include linguistic capabilities.

B. Societies in industrialized countries should:

1. Facilitate and increase the participation of scientists and engineers from developing countries in their activities.

2. Strengthen or form permanent committees for continued contact with sister societies and other appropriate partners in developing countries.

3. Seek devices that would permit their colleagues from developing countries to enjoy the advantages of those societies without cost, or at reduced cost.

4. Share information and expertise on society management.

C. Scieties in both industrialized and developingcountries should:

1. Establish formal liaisons between each other, along serveral possible axes: North-North, North-South, South-South.

2. Hold conferences and workshops which focus on multi- and inter-disciplinary aspects of problems relevant to a specific country or region.

3. Undertake collaborative projects on development problems.

4. Establish links between subdisciplinary or working groups so that these groups can focus on problems such as: identification of research problems, the establishment of research priorities, the development of research programmes and design for policy implementation.

5. Create awards for achievements in international development.

6. Encourage the youth of both sexes and of minority groups to join in the scientific and engineering professions.

II. *Planning and evaluation for development purposes should be increasingly addressed by scientific and engineering societies as part of their activities.*

The goal of greater professional society involvement in development can only be realized if there are changes in traditional attitudes and approaches. Professional societies in both industrialized and developing countries should extend their goals and interests beyond their traditional functions of publication, information dissemination and promotion of scientific excellence within their disciplines. They have a unique role to play in identifying situations where a radical change in technological approaches may be essential if projected development goals are to be realizable. They can play a catalytic role in accelerating the interaction between the technical communit and those involved in development planning and evaluation in developingcountries.

Scientific and engineering societies in all countries should be more involved in policy formulation and planning. In particular there should be more interaction between working scientists as represented by the societies and policy planning officials who make decisions about the allocation of funds and other resources for science and technology. This should be a two-way interaction in which the scientists gain a better appreciation of the realities of development problems and the constraints under which development planning operates, while officials gain a better appreciation of opportunities arising from science and technology and the limitations and time constraints in the practical application of science to development.

Specific Recommendations

A. Scientific and engineering societies in both industrialized and developing countries should:

1. Extend their goals and interests beyond their traditional functions of publication, information dissemination, and promotion of scientific excellence within their disciplines to embrace the problem of development.

2. Mobilize—individually and jointly—their intellectual resources to provide input to national development planning and to the evaluation of national development plans from a technical perspective.

3. Work at clarifying development objectives and identifying within them critical scientific and technological issues, which then could be attacked by more specialized groups.

4. Be prepared to examine and evaluate government policies and programmes in order to develop greater interaction between development planning and research and development allocations.

5. Forge closer links with industry and with other institutions directly engaged in development or development planning.

6. Undertake ad hoc technology assessments of development plans where success is sensitive to scientific and technical considerations. These assessments must be interdisciplinary and will usually require collaboration among societies.

7. Take full account, in all evaluations and estimates, of local aspirations and material constraints, while attempting to distinguish between those values that should be preserved and those that pose fundamental obstacles to development.

8. Become more oriented towards the implications of socio-economic projections as a basis for identifying critical needs for new technologies and highlighting these needs for science policy planners.

9. Strive to keep government officials and policy makers informed of relevant technological developments. One way to achieve this is for societies to hold science and technology briefings for government decision makers, the public and media.

10. Be prepared to assist their government in adopting the technologies most appropriate to the development of their country.

11. Alter the scientific reward structure to accord greater recognition to practical contributions and to ingenious adaptation as well as to original research.

B. Societies in the developing countries should:

1. Play a role in the assessment of technologies proposed for implementation of development plans in terms of their wider social and environmental impacts. This can be done in collaboration with societies from industrialized countries.

2. Broaden their goals by striving to identify their national development needs, each in its own field of specialization, besides identifying the needs of their own members.

III. *Societies should expand and emphasize their contribution to the education and training of scientists, engineers and technicians for solving development problems.*

Participants agreed that scientific and engineering societies have a definite role to play in general to develop exchange programmes for scientists and engineers; assist in retraining and developing continuing education courses; strengthen the applied social sciences as they relate to development; cooperate, where appropriate, in developing curricula focused on technology for development; assist in technician training programmes, promote cooperation between industrial and academic scientists and engineers in industrialized countries and in developing countries.

Specific Recommendations

A. Scientific and engineering societies in industrialized countries should:

1. Stimulate the establishment of professional societies in developing countries to ensure that continuing education be pursued according to local needs.

2. Educate their constituents about the problems of development.

3. Inform societies in the developing countries on the availability of educational literature. Samples of such literature should be provided for local adaptation. Proper legal and/or financial means should be sought to solve the copyright problem and to allow for indigenous reproduction.

4. Encourage the adoption of rules allowing students from a developing country to share graduate thesis education between that country and an industrialized country.

B. All scientific and engineering societies should:

1. Create mechanisms of continuing education that will minimize technical obsolescence. Programmes of life-long learning should be encouraged.

2. Assist in retraining and in developing continuing education courses for scientists and engineers.

3. Become more actively concerned in developing countries with the training and performance of technicians and of skilled workers related to the general fields of their competence. There exists a gap of manpower of technicians below the level of technically trained professionals. This gap must be narrowed and this can be done by creating instructional programmes headed by individuals who are skilled in both areas. It is further proposed that attention be given to the continued training of technicians.

4. Create mechanisms (individuals or committees) that will maintain surveillance of their governments' legislative actions as they relate to professional education. Where legally possible, influence should be brought to bear to achieve desired improvement.

C. Scientific and engineering societies in the developing countries should:

1. Help in the definition and identification of regional and local needs. This should be done with the cooperation of the scientists and scientific bodies within the region. It is suggested that societies refrain from establishing a single global approach to training and education.

2. Perform a continuing evaluation of local needs in education. It is further recommended that societies create (where none exists) divisions or sections devoted to the development of education.

3. Encourage training to be compatible with the home or local environment.

4. Adapt existing literature and other instructional media to the local environment.

5. Produce this literature in a locally understood and locally usable form.

6. Provide career guidance and other information to their members to help alleviate the "brain-drain"

7. Establish whenever possible short term joint education and training institutes on a regional or international basis in order to be as cost effective as possible. At some later day, such institutes should be nationalized, moving from an international to a national support basis

IV. *The ability of scientific and engineering societies to collect, evaluate and communicate information should be directed increasingly toward development.*

The participants concluded that the priority domains for scientific and technological information transfer should be the following: agriculture, small rural industries, health, environment, and local energy sources. It is important that scientific and engineering societies assist in directing information necessary to those involved in these areas. Bilateral agreements between corresponding societies have demonstrated usefulness in providing solutions to the difficulties in information dissemination. The direct exchange of literature is beneficial, but its utilization may be limited by language barriers. More effective is the exchange of members, exchange of bibliographies containing titles and abstracts, as well as focusing on specific problem areas of mutual concern.

Specific Recommendations

A. All scientific and engineering societies should:

1. Facilitate the transfer of information at three major levels:

(i) among professional peers in order to further research and development

(ii) among technicians who apply basic science in development efforts

(iii) in the public domain at all age levels, in order to enhance the popular understanding of science and to encourage young people to enter scientific and technological careers.

2. Investigate methods for joint publication.

3. Select the most cost-effective and appropriate form of information transfer and exchange from such forms as: books, magazines, abstracts, microfilms, microfiche, computer-compatible magnetic tapes, on-line service, individual consulting assistance, and organized meetings, workshops, seminars, symposia and conferences.

B. Scientific and engineering societies in developing countries should:

1. Develop cost-effective techniques for translating, disseminating and popularizing the pertinent literature in native languages. Although English and Russian are currently the most prevalent languages for scientific and technical information, further work in the direction of solving the language problem is necessary.

2. Develop teaching aids to elucidate essential principles of science and technology in a form of analog (non-verbal) language.

3. Encourage publishers republish important books in countries where production is less costly and books could be sold in markets not currently developed at lower prices on a regional basis.

4. Update an earlier survey made by UNESCO of the local conditions in Africa, and initiate activities to define actions relevant to those conditions.

V. *The United Nations, National Governments, private foundations, and societies should together develop plans and funding mechanism for bringing scientific and engineering societies into development projects where practical.*

External financial support will be necessary to accomplish many of the goals stated above. For example, it will be necessary to facilitate the transfer of scientific and technological information by whatever means. The transfer and exchange of scientific and technical information will have to be effected at the lowest possible cost. Since information is expensive this can be accomplished by subventions, through the societies, from governmental sources, from private foundations, and/or by variable pricing of publications according to country, region, or size of society membership.

Small societies suffer from lack of financial resources to perform the function desired, particularly in the dissemination of information to their members and the public. It was recognized that some financial assistance is needed, particularly for the intial acquisition of literature.

To aid in seeking funding for multidisciplinary efforts of scientific and engineering societies focused on development, it is proposed that efforts be directed towards generating a list or lists of funding organizations.

Specific Recommendations

A. Funding will be necessary to:

1. Compile the Directory of Scientific and Engineering Societies mentioned above.

2. Publish books of importance to the members of the society, such as abstracts in specific disciplines.

3. Enable national societies to become affiliated with international organizations with the aim of improving the flow of information.

4. Allow individual scientists and engineers from developing countries to attend international meetings.

B. The participants urged the United Nations Interim Fund and other international agencies to consider the above suggestions for support. They further urged that scientific and engineering societies be involved in the planned conference that will identify specific cooperative projects for support by the Interim Fund.

C. Governments should recommend that scientific and engineering societies be able to receive support directly from the United Nations Interim Fund for Science and Technology for Development.

VI. *The momentum created by the Seminar should be maintained and a continuing committee chosen from the participants to coordinate follow-on actions.*

Specific Recommendations

A. The Proceedings and/or Summary Report of the Global Seminar should be widely disseminated.

B. A Continuing Committee chosen from the participants of the Seminar should be created to maintain the momentum.

C. Articles relating to the Seminar should be published in the journal of each society represented at the Seminar.

D. These articles should be later collated and circulated in the form of a supplementary proceedings, or perhaps in the form of a newsletter.

E. AAAS should follow up later actions by the participants and communicate the results. Again this could be done in the form of a newsletter.

F. Societies in all countries, industrialized and developing, should seek to maintain the momentum created by this Seminar by promoting the continuity of this endeavour through similar seminars, workshops, and conferences in the future.

WORKING GROUP 1.
Applied Research and Development

Co-Chairmen:	
M AHMED	*Bangladesh*
C COONEY	*USA*
M KAMCHORN	*Thailand*
Rapporteurs:	
J W MCGOWAN	*Canada*
S C PANDEYA	*India*
Participants:	
A A ABUZINADA	*Saudi Arabia*
J F ARENS	*The Netherlands*
O J DU TEMPLE	*USA*
MA JI	*People's Republic of China*
S G RAMACHANDRA	*India*
O SALA	*Brazil*
M SINGH	*Malaysia*
S VARDARAJAN	*India*
M K WALI	*USA*
E F R WHEELER	*Australia*
WU JINCHENG	*People's Republic of China*
D ZINBERG	*USA*

WORKING GROUP 1

Applied Research and Development

1.0 Applied Research and Development

1.1 National and International Support

Many countries believe that a national, science-based research enterprise contributes significantly to economic and social wellbeing. Yet more than 90% of research and development activities in the world are carried out by scientists, social scientists, and engineers in countries in the North which constitutes less than one-quarter of the world's population. Only a small fraction of this research relates to the needs of underprivileged peoples. The remaining 10% of the research and development activities are carried out in the South, where there is a shortage of resources—both human and financial—and where problems related to food, energy, shelter, environment, medicine, population and communication often receive inadequate attention.

Since the founding of the United Nations, world government has attempted to impose solutions to problems by fiat, and as such, the necessary programmes for research and development are often ineffective. The UNCSTD meeting in Vienna (1979), an example of "top-down" decision-making, has failed to meet the goals it set and was, consequently, ineffective. Only a small fraction of the funds requested for developmental research $250 m has been identified; even a smaller fraction has been given to the world community for action, $50 m. These rest with the recently developed UN Interim Fund for Science and Technology for Development while other funds are pledged by countries like Canada to be administered by national agencies like the the International Development Research Centre (IDRC).

A number of countries have attempted to supplement UN efforts by establishing agencies such as AID (the Agency for International Development) in the United States and the International Development Agencies in Canada and the Scandinavian countries. More recently some OPEC countries have contributed substantial funds for development.

The establishment of research support agencies such as the Canadian IDRC, the Swedish Agency for Research Cooperation (SAREC) and the Netherlands Universities Foundation for International Cooperation (NUFFIC) has contributed substantially to development related studies in developing countries. Unfortunately, the US effort to establish an IDRC counterpart, the Institute for Scientific and Technological Cooperation (ISTC), has thus far failed in the US Senate.

Within the last decade the International Foundation for Science (IFS) whose home is in Stockholm was established and it is now supported by nearly 60 National Academies and Royal Societies. Through its efforts each year nearly 50 research grants of 10,000 US dollars or less each are given to scientists in developing countries in order to motivate and mobilize younger scientists in universities and national research institutes within developing countries to undertake high-quality original research on problems of importance within their own countries. Thus far they have supported the biosciences and agrosciences with no support for the mathematical, physical or material sciences as they relate to problems of development.

As one reviews activities of different organizations which have played an important role in development, one would be remiss not to recognize the countribution of non-governmental organizations (NGO's). However, by and large they have not contributed to a large research and development component. One of the few exceptions is the ICSU Committee on Science and Technology for Development in Developing Countries (COSTED). It has functioned as an international broker requesting funds for workshops, travel, teaching, and other activities which have made disciplinary and multidisciplinary programmes for development possible.

The focus of this global gathering is upon the national and regional scientific and engineering societies and those national and regional groupings of societies which have brought together scientists and engineers from many disciplines in order to work on research related to development.

1 2 Points Emphasized in the Discussion

With the preparation for UNCSTD, few topics have received more international attention than science and technology for development. Still the exercise of bringing together scientists, including the social scientists and engineers representing a myriad of societies, to once again rethink the problem has been invaluable.

Special emphasis was placed upon the need for disciplinary and multi-disciplinary societies in more industrialized countries to help their counterparts in developing countries. It was felt that this help can best be given through an exchange of people, information and the development of joint projects and topical seminars. When possible the workshops and seminars should include some aspect of multi-disciplinary work, since the problems in development are by their nature multi-faceted.

An attempt was made to identify applied research themes in which scientific and engineering societies might jointly participate. But, because it was impossible to identify any specific project to which this large group could give its attention, it was recommended that the Global Seminar work through and with the U.N. Interim Fund for Science and Technology for Development and the International Federation of Institutes for Advanced Studies (IFIAS) to establish project priorities. These priorities once established should then be brought to the attention of the disciplinary and multi-disciplinary societies throughout the world for action.

Two issues demanded the bulk of our attention:

(a) The strengthening throughout the world of disciplinary societies and ways of encouraging their effective participation in applied R & D for development.

(b) The identification of specific activities within each scientific and engineering society which might be pursued in conjunction with other societies in the world.

The following activities on the part of societies were identified as important:

(a) The establishment of formal liaison between co-sponsoring societies within developing countries and between societies in industrialized countries with their counterparts in developing countries.

(b) The organization of workshops, seminars and symposia jointly sponsored by societies in developing and under-developed countries.

(c) The development of exchange programmes for scientists and engineers through which expertise can be shared.

(d) The establishment of organic links between groups working in the field of applied research such as: (i) The management of professional societies; (ii) the identification and framing of joint research programmes; and (iii) the identification of research priorities.

(e) The establishment of special methods for the exchange of scientific and technical information like newsletters, joint publications, etc.

(f) The establishment of educational programmes leading to the training and continuing education of scientists, and the training of technicians. This will include the development of special recommendations for curricula in technical colleges.

It was recognized that both financial assistance and the identification of workers in development were important for the success of programmes. It was therefore suggested:

(a) That we should use agencies such as the ICSU and its Committee on Science and Technology for Development (COSTED) to assist with developmental workshops and seminars which focus upon development problems.

(b) That we should request that governments allow funds now controlled by the UN Interim Fund to be made available to societies for development.

(c) That an exhaustive list of scientists and engineers and disciplinary and multi-disciplinary groups which are involved in development be compiled and bi-annually updated.

It was felt that the important area of "applied research for development" should receive due status within the scientific and engineering societies and that awards should be established to recognize excellence in this area.

It is important to identify a mechanism whereby applied research projects for development can be reviewed and evaluated. This should be the first step for further action.

Scientific and engineering societies should be involved in the planning process for development within nations and groups of nations. Societies were urged to hold briefings for governmental decision-makers on a regular basis.

Societies have the responsibility to educate their members and the general public on matters dealing with science and technology for development. This must include continuing interaction with the media.

1.3 Identification of Problem Areas and Proposed Actions

The following problems were identified by this working group as important and specific actions were recommended to the Global Seminar.

1.3.1 Problem: Many scientific and engineering societies in developing countries need strengthening in order to contribute effectively to development.

Proposed Action: Scientific and engineering societies should establish a link between corresponding societies in industrialized and developing countries as well as between societies in developing countries.

They should attempt to:

(a) Establish formal liaisons between corresponding societies in developing and industrialized countries.

(b) Establish formal liaisons between corresponding societies in other developing countries.

(c) Hold joint disciplinary and interdisciplinary conferences and symposia on topics relevant to development.

(d) Develop exchange and visitors' programmes for scientists and engineers.

(e) Share information and expertise on society management.

(f) Establish links between subdisciplinary or working groups so that these groups can focus on problems such as: (i) the identification of problems, (ii) the establishment of research priorities, (iii) the development of research programmes, and (iv) the design for policy implementation.

(g) Establish methods for scientific information exchange, e.g., joint publications, newsletters, etc. where feasible.

(h) Assist in retraining and in developing continuing education courses for scientists and engineers.

1.3.2 Problem: Development is multifaceted and involves multiple scientific, social and engineering disciplines.

Proposed Action: Scientific and engineering societies should establish mechanisms by which relevant disciplines can be brought together to address problems of development.

More specifically, they should:

(a) Hold conferences and workshops which focus on multi- and interdisciplinary aspects of problems relevant to a specific country or region. Examples of topics should include: food, energy, population control, environment, communication, desertification, water resources, reconstruction of ecosystems and human resource development. These meetings should not only facilitate information exchange but also should lead to scientific collaboration.

(b) Utilize, where possible, existing networks, e.g., COSTED, to provide a means for organization and communication between scientific and engineering societies.

(c) Strengthen the applied social sciences as they relate to development.

(d) Seek funding for multidisciplinary efforts of scientific and engineering societies focused on development. This will be facilitated by reducing the national and international barriers to funding of scientific and engineering societies.

(e) Compile and continually update a roster of individuals and societies by discipline who are experts in and have interest in problems of developing countries.

1.3.3 Problem: Applied research for development does not receive sufficient attention from scientific and engineering societies, universities and research institutes.

Proposed Action: Scientific and engineering societies should increase their attention and involvement in problems relating to development, and encourage universities and research institutes to do the same.

For example, they should attempt to:

(a) Develop means to better inform and educate scientists and engineers in industrialized countries about problems of development through symposia, joint conferences, publications, etc. It would be desirable to hold symposia routinely on problems of development at the annual meeting of societies.

(b) Increase the participation of scientists and engineers from developing countries in societies of industrialized countries.

(c) Where appropriate, cooperate with universities and research institutes in developing new curricula which focus on technology for development.

(d) Assist in the initiation and development of technician training programmes.

(e) Promote cooperation between academic and industrial scientists and engineers in developing countries, and between industrialized and developing countries. This could be accomplished through workshops, joint conferences and by visits by university and industrial scientists and engineers from developing countries in universities and industries in industrialized countries.

(f) Develop methods by which joint working groups can evaluate collaborative projects so that both failures and successes can be analyzed to provide a basis for further action.

(g) Establish awards for achievements in international development through the societies or an organization such as COSTED.

1.3.4 Problem: There is inadequate involvement of scientific and engineering societies in the policy formulation and planning processes which lead to decisions in development.

Proposed Action: Scientific and engineering societies should be more actively involved in development and evaluation of policy-planning.

For instance, they should:

(a) Hold science and technology briefings for decision-makers in the government.

(b) Develop the means, where feasible, to participate routinely in government hearings and planning session on development.

(c) Encourage their members to be more involved as advisors to appropriate government agencies and decision-makers.

(d) Develop programmes to educate the public on problems of science and technology in development. One approach would be to educate the media on the substance and significance of these issues. At the same time, scientific and engineering societies should initiate programmes to educate their own members about those factors—social, economic and political—that may ultimately determine the acceptance or rejection of scientific and technological innovations.

1.4 Recommendations for Specific Actions

1.4.1 Governments should recommend that scientific and/or engineering societies be able to receive support directly from the united Nations Interim Fund for Science and Technology for Development.

1.4.2 Scientific and engineering societies should be involved with arrangements currently being made through IFIAS (International Federation of Institutes for Advanced Studies) by the Interim Fund for a conference of science practitioners to be held in mid-1981 that would identify specific cooperative research areas in development for support by the Interim Fund.

1.4.3 COSTED (Committee on Science and Technology for Development) or similar organizations should be requested to act on behalf of scientific and engineering societies in interacting with IFIAS and the Interim Fund to report and recommend to scientific and engineering societies specific areas needing action and in which scientific and engineering societies can participate.

1.4.4 Scientific and engineering societies in industrialized and developing countries should establish international committees to address development projects and interact with other scientific and engineering societies. These committees should examine specific projects and establish liaison with other societies that could lead to collaborative projects.

1.4.5 Seed funds should be established by scientific and engineering societies to assist with multi-disciplinary and interdisciplinary activities such as workshops on applied research for development in developing countries.

1.4.6 Scientific and engineering societies should organise workshops on specific problems relevant to country or region. These workshops should be held in an appropriate developing country.

1.4.7 Scientific and engineering societies should take specific actions to institute cooperative applied research projects between developing and industrialized countries in the areas of environment, food, energy, communications, population control, ecosystem reconstruction including desertification, water resource development, and human resource development.

WORKING GROUP 2

Scientific and Technological Information

Co-Chairmen:	
L COHEN	*United Kingdom*
M DRAGANESCU	*Romania*
M ROCHE	*Venezuela*
Rapporteurs:	
G A DOUMANI	*USA*
A P MITRA	*India*
Participants:	
J DEBELIUS	*Federal Republic of Germany*
M L ESMAY	*USA*
N L GONZALEZ	*USA*
H A KADDAH	*Egypt*
J L KELSAY	*USA*
Y S MURTY	*India*
B T NAGRANI	*India*
J T RATCHFORD	*USA*
B SINHA	*India*
L N SUMAROKOV	*USSR*
TAN DU	*People's Republic of China*

WORKING GROUP 2

Scientific and Technological Information

2.0 Scientific and Technological Information

The transfer of technology for development is either a process of acquisition, adaptation, and adoption of imported technology or of generation of indigenous technology. This process is primarily a two-way information and communication process. The basic requirements for this process can be grouped into: (1) sources of information, (2) means of information acquisition and exchange, and (3) financial resources to transfer or to exchange information. Information exchange through professional societies provides advantages often lacking in elaborate international systems. Information sharing based on exchange among corresponding scientific and engineering societies would address selected subjects and focus on well-defined needs requiring specialized data, often generated by the professional societies themselves. Transfer and exchange of scientific and technical information should be carried out without inducing further polarization in the scientific and technological balance in the world. On the contrary, the aim should be to evolve technologies for development which are compatible with socio-economic frameworks in the developing countries which can benefit greatly from the transfer and exchange of relevant scientific and technical information within and between the developing countries. This process certainly should not exclude interaction between developing and industrialized countries. In the field of pure research, which has universal characteristics, the interaction must be carried out across the world, and should not polarize within either the developing countries or just among the industrialized countries.

This working group examined the basic definition of societies and the functions they are expected to perform. The societies were evaluated in terms of functions which serve the purposes of the society's members as well as those essential for national need and international cooperation. Information transfer and exchange take place at different levels, each with significance to users possessing varying degrees of scientific and technical knowledge. Three major domains were identified, and were used as a framework for workshop deliberations (item 2.1.2, below).

2.1 Points Emphasized in the Discussion

2.1.1 Scientific and Engineering Societies

Scientific and engineering societies are defined in broad terms as groups of specialists in one field or a group of related fields, with the aim of promoting professional knowledge among their members, advising their countries (government and public) in matters of scientific and technical nature, and providing cooperation with corresponding foreign societies with mutual interests.

It was recognized that different countries have different definitions of societies, associations, syndicates, academies, etc., but the term "societies" shall be used for the purpose of this seminar to fit the general sense and definition expressed above.

2.1.2 Transfer of Information

Transfer of information should be facilitated in three major domains:

(a) among professional peers in order to further research :

(b) among technicians who apply basic science in development efforts;

(c) in the public domain at all age levels, in order to enhance the popular understanding of science and to encourage young people to enter scientific and technological careers.

2.1.3 Major Elements Essential for Transfer and Exchange of Information

The major elements considered essential to facilitate the transfer and exchange of information on a global scale as well as the national and community levels are the following :

(a) To facilitate cooperation among scientific and engineering societies, it is desirable to have a world-wide Directory of Scientific and Engineering Societies. This Directory would be classified into major fields and disciplines; cross-indexed under country, region etc.; and contain descriptive information on each society. The directory should be revised and updated periodically, annually if possible, and the actual compilation should be performed by a society or a group of societies possessing the facilities, manpower, and experience to implement this project under the overall supervision of an international steering committee.

(b) Small societies suffer from lack of financial resources to perform many of their needed functions, particularly as related to the dissemination of information to their members and the public. It was recognized that some financial assistance to societies is needed, particularly for the initial acquisition of literature.

(c) Bilateral agreements between corresponding societies have demonstrated usefulness in providing solutions to the difficulties in information dissemination. The direct exchange of literature is beneficial, but its utilization may be limited by language barriers. More effective is

the exchange of members through formal and informal programmes and participation in scientific and engineering meetings and seminars, exchange of bibliographies containing titles and abstracts, as well as focusing on specific problem areas of mutual concern.

(d) The transfer and exchange of scientific and technical information will need to be effected at the lowest possible cost. Since information is expensive this generally must be accompanied by subventions to the societies, from governmental sources, from private foundations, and/or by variable pricing of publications according to country, region, or in the case of very large societies, spreading the costs over the society membership.

(e) The societies should be able to select the most cost-effective form of information transfer and exchange from such forms as: books, magazines, abstracts, microfilm, microfiche, computer-compatible magnetic tape, on-line service, individual consulting assistance, and organized meetings, seminars, symposia and conferences.

(f) Although English and Russian are currently the most prevalent languages for the transfer of scientific and technical information, societies in developing countries should devise cost-effective techniques for translating, disseminating and popularizing the pertinent literature in their native languages. Further work in the direction of solving language problem is necessary. Development of teaching aids to elucidate essential principles of science and technology in a form of analog (non-verbal) language should be included.

(g) Societies should strive to identify and serve national development needs of their countries, each in its own field of specialization, besides identifying and serving the needs of the society members.

2.2 Advice to Policy-making Bodies

Financial appropriations for science and technology are in the hands of policy-makers. In order to tap these resources for an adequate and appropriate portion of the GNP, the societies should strive to keep government officials and policy-makers informed of relevant technological developments. Educating policy-makers will also assist the government in making appropriate choices in selecting technology for the development of the country. The policy-making bodies of a country are important targets for the professional societies as they perform information and assistance functions.

2.3 Priority Areas for Scientific and Technical Information (STI) Transfer

The priority areas for STI transfer should be the following:

(i) Basic scientific and technological information in all disciplines

(ii) Agriculture and related fields

(iii) Small-scale rural industries

(iv) Health

(v) Environment

(vi) Local energy sources and utilization devices

It is important that the necessary information reach those directly involved with the help of scientific and engineering societies.

2.4 Recommendations

2.4.1 Besides the World-Wide Directory recommended above (item (2.1.3 a)), societies in developing countries need and should seek the following:

(a) To encourage publishers to republish important scientific and engineering books and sell them at lower prices in developing countries where production is less costly. These books would be made available on a regional basis in markets not currently developed.

(b) To seek funds and/or subsidies for publishing books of importance to the members of the society. Sources of funds may include industrialized country assistance programmes, United Nations agencies, private fundations, etc.

(c) To seek financial aid or concessions for affiliation with international organizations with the aim of improving the flow of information.

(d) To seek subsidies for special publications, such as abstracts in specific disciplines.

Some of the above, should be considered for support by U.N. Interim Fund and other International Agencies.

(e) To establish and maintain contact with government officials and policy-makers, providing them with scientific and technical information relevant to the planning process.

2.4.2 Finally, societies in all countries, industrialized and developing, should seek to maintain the momentum created by this Global Seminar by promoting the continuity of this endeavour through similar seminars, workshops, and conferences in the future.

2.5 Importance of Global Seminar

The participants recognize the importance of this Global Seminar in promoting the exchange of information and, hence, facilitating and enhancing the commitment of the scientific and engineering societies to development. Therefore, it is recommended that the momentum be maintained, and continuity promoted for similar seminars in the future. A seminar within two years, for example, would be essential for updating our present work and studying the feedback for future planning.

WORKING GROUP 3

Scientific and Technological Education and Training

Co-Chairmen:

H C BOSTROM	*Federal Republic of Germany*
R C ZELEDON	*Costa Rica*
ZHANG WEN-QI	*People's Republic of China*

Rapporteurs:

R C BRASTED	*USA*
A SHARMA (MRS)	*India*

Participants:

R S BHATHAL	*Singapore*
P K BOSE	*India*
J N O FERNANDO	*Sri Lanka*
H GROVER	*India*
R GUILLAUMONT	*France*
S KAHNE	*USA*
F C LEONE	*USA*
T V MARCHENKO	*USSR*
A S MAWENYA	*Tanzania*
C R MITRA	*India*
D W MORLEY	*United Kingdom*
A S N'DIAYE	*Ivory Coast*
K POLINSZKY	*Hungary*
C N R RAO	*India*
I SAAVEDRA	*Chile*
W M SANGSTER	*USA*
C E SEVERIN	*USSR*
B WINID	*Poland*
M A YADAROLA	*Argentina*

WORKING GROUP 3

Scientific and Technological Education and Training

3.0 Scientific and Technological Education and Training

3.1 Points Emphasized in the Discussion

The position papers submitted by the members of Working Group 3 covered a wide spectrum. They ranged from specific activities engaged in by scientific and engineering societies in the countries of the authors, to needs that might be served in developing countries by societies in industrialized countries.

Eleven issues or areas were identified as a result of very brief oral summaries of the position papers and the debate that ensued based upon these papers. Certain of the issues are consolidations (since the original list was a very long one), certain others are and indeed will continue to be controversial. Not all participants agreed that some areas were either of equal importance or even represented problems within their own geographic regions. A missing, but debated issue was that of "development" as it might apply to education and training. The term meant different things to different people and/or geographic areas.

3.1.1–2 Regional Approach and Quality

1. The regional approach, including the problems of defining the boundaries of a "region."

2. Quality of instruction in opposition or contrast to quantity; different problems in different regions or countries.

It was a consensus that the above two items 1 and 2, Regional Approach and Quality are inseparable. The regional approach would be important in maximizing quality of education. The members of the Group were unanimous in their belief that unique problems exist in unique geographic regions. As an example developing and least developed countries amongst the African nations have a common purpose in education not likely to resemble or be common to those of, for example, India, Pakistan, or Bangladesh. In turn these might be quite foreign to those encountered in Latin American countries. Other regional similarities and disparities could be defined. Some progress has been reported in the formation of consortia and/or federations such as groupings of Central American countries. It is necessary for the scientific and engineering societies of industrialized countries to help in the definition

of the needs within these regions utilizing the cooperation of the residents and whatever professional societies already in existence within them. *Thus no single "international" approach should be expected, though one can expect common international standards of excellence in scientific and engineering education.* The geographic subdivisions or regions defined by the U.N. could be used to develop educational systems on a regional basis.

Quality and quantity in education should be measured against or in terms of the specific needs of a given region. For instance, a "particle beam physicist" would have little to offer in a region where the facilities for his field of experimentation (or use of a product) are non-existent. Continuous evaluation of needs is important as development progresses within a region. National societies can play a useful role in this evaluation. Manpower-planning is needed to establish the quantity as well as quality. Here and elsewhere, in the several positions that have already been stated, the need for continuing education is evident. The concept of useful half-life (L 1/2) for all professionals is pertinent. An engineer may be thought of as losing half of his or her effectiveness each 8 working years. One could estimate then that in some 16 years he or she would be of little use or able to maintain either vitality or viability within a profession. In other areas, especially in pure sciences, the "half life" (L 1/2) may be less than the eight-year period suggested earlier. *National societies that do not already have such should create the mechanism for training and refresher programmes.* Societies that do maintain programmes should share their expertise. For example, the American Chemical Society (ACS) provides short courses in technical subjects that are available in the form of films, tapes, and, as such, can be of worldwide use. *It is important that some sort of clearing house be established to publicize the availability of such audio and video materials.* The importance of attracting young people of both sexes and of minority groups should be stressed to keep the discipline both alive and improving.

3.1.3–4 Academies of Science and Scientific and Engineering Societies and Their Role in Educational Development:

3. Academies (national policy-making groups) vis-a-vis scientific and engineering societies; the role of each.

4. The role of societies in education and training especially as it relates to continuing education or lifelong learning.

A consolidation of issues was assumed as being reasonable considering together academies of science and scientific and engineering societies and their respective roles in development. Since national academies neither exist worldwide, nor have a common type of membership, care must be exercised in defining and differentiating their roles from those of scientific and engineering societies. It was recognized that a gap exists in the training of technicians as opposed to more academic graduate training. The former represents a "National Treasure" since as many as a dozen or more support personnel (this is, those technically trained) are needed for each research scientist (graduate trained). The gap, when it does exist, may be bridged by

creating training programmes which are taught by persons skilled in both areas. Another "gap" exists in the industrial versus the academic-professional fields as will be mentioned later. Instruction is most meaningful when conducted by staff with industrial experience. In some countries, the academies look to the scientific and engineering societies to carry out their policies. In others, the academy is the scientific policy-making body and consults with the government (and vice versa). Returning to continuing education, *the participants were united in recommending that scientific and engineering societies create divisions or committees to oversee the various cures to technical obsolescence.*

Not all of the scientific and engineering societies represented in the group reported having an international "component." When and where such a component does not exist, *it is proposed that it be created along with the aforementioned continuing education arms.* Within the education component, it is proposed *that evaluation and accrediting units be established to help assure quality.* Again, academies can usually only recommend. All do not have financial resources to be "action bodies." *Manpower* studies should be made at frequent intervals. A danger inherent to a professional society conducting such surveys may be that the results could be said to be "self-serving," unless financial support to accomplish the surveys is provided by a central government.

A controversial point was one of devising and maintaining standards once a society, (perhaps through an academy request), had established them. Some societies, for example ACS, have such active and influential accrediting bodies. *It is suggested that where such systems are already operating, a clearing house be established to take advantage of the available expertise.*

3.1.5 International societies, the creation of one society from another or the sponsorship of one by another.

As scientific and engineering fields progress and as countries develop technologically, there emerges a need for societies or groups that will represent common scientific and technical interests. *It is recommended that national and international societies aid in the creation of sister societies in emerging countries or in countries where such do not currently exist.* The participants recognize the danger of duplication or of creating something for which there is little need. An example was cited of a positive effort in establishing joint engineering societies in two neighbouring nations, Venezuela and Argentina. It must always be borne in mind, however, that there can exist language barriers; in a very large percentage of the cases, a commonality of language will not exist. If intersocietal actions are to be taken, it is necessary that individuals with language facility be involved. One professional society (ACS) has in the discussion stage the creation of an International Directory of Chemists designed to include the academic personnel of most of the world universities. Although the creation of such a volume represents a monumental task, it is suggested that it could include (in addition to their speciality areas and research interests) the linguistic capabilities of university scientists. If such a volume proves to be successful, it might be possible for other scientific and engineering societies to create similar reference sources.

A negative factor related to international societies is their usual financial dependence on contributions from national groups. Some such societies are sufficiently expensive to discourage emerging countries (individuals or their own societies) from joining or even maintaining membership. *It is proposed that some means be devised to allow for reduced fees for those developing countries unable to bear the burden.* Still in the financial sector, another problem is the ever burgeoning cost of travel to international meetings. Some items of business can only be accomplished on a face-to-face basis. A consequence of the escalation of travel costs in the future may be the absence at such meetings of the most important segment of membership, those who would derive the greatest benefit. *A proposal is suggested which involves the production and circulation of a list of organizations, whether they be government, private, industrial, or philanthropic, that are designed to provide such financial help.* It is not unreasonable to think that OPEC countries might be willing to underwrite programmes of international flavour.

3.1.6 Scientific and engineering societies as they interact with local governments; the potential of dictation by government in education and training (at all levels) policy.

The inherent problems of government influence on a profession was recognized but to different degrees by the working group participants. In some countries, the influence may be quite different from that in others. In some cases, by their defined constitutional right, the central government is responsible for the education of the people at virtually every level. Government support on the other hand, may eventually result in indirect but nonetheless very powerful influence on education and research policies. This influence is much more easily recognized in research than in teaching though both are subject to control. Some scientific and engineering societies maintain special offices, committees, and/or selected individuals, that keep the membership abreast of legislation that affects education as well as other aspects of the profession. The creation of such committees, thought of as "Membership Affairs," or "Public Affairs," might be appropriate for scientific and engineering societies. It would be the responsibility of these units to report on legislation as it might concern members. It is a natural law that if the scientific and engineering societies do not govern and regulate their own affairs in a proper fashion, regionally as well as internationally, some other unit or group will step in, so-to-speak, to "fill the vacuum." It would be unfortunate if this, by default, were the government. It was recalled that more than once in history governments have changed with the consequence that areas have been divided between several countries. The creation of these new nations has necessitated changes in professional orientation and educational structure. Joint decisions on the educational structure could be made to mutual advantage and result in great cost savings. *For example, a single institute might be created to serve several geographically related nations, assuming that a common language exists.*

3.1.7 The "Brain-Drain"

With the possible exception of the working group's attempt to define "development," this item was one of the most closely contested and debated, not only in

terms of meaning, but in the feasibility of any one seminar, conference, or congress to really come to grips with the problem. It was even debated whether it represented a problem. Whatever the causes, financial or otherwise, a number of solutions (with accompanying problems) were identified. Centres of excellence in research and education might be created to minimize the movement of personnel to the industrialized countries where most emerging or developing country student and trained populations seem to move. This suggestion, in the end, seemed to be self-defeating and with little merit since it would only duplicate laboratories and libraries, as well as other instructional facilities. It would be far better if the industrialized countries could focus on the needs of the developing countries to train persons with the skills that are needed in that particular region (Item 1). *Thus, more effort might be put on joint graduate training with part or all of a doctoral or master's thesis being done in the native or home country. Supervision and basic course instruction would still be accomplished in the university of the industrialized country.* Such programmes do exist but often university graduate schools and administrations are reluctant to accept the concept. It is true that there will be obligations imposed by the funding source as to how and on what subject a thesis can be produced. This restriction could result in governments responsible for funding having little sympathy with this joint research plan.

Career opportunities that exist in the developing countries and/or emerging countries should be better advertised. Accompanying the advertising process, however, there must be opportunities and proper working conditions as well as up-to-date equipment. Stipends must be adequate to make the return or desire to return attractive. As important as pride in one's country, providing the necessities of life will essentially be the motivating force. Simplistic solutions do not exist.

It was further proposed that *reference materials be made available describing the potential within an emerging country.* Those who hire trained personnel (or graduate students) in an industrialized country could benefit from more information on the obligations that a student may have to his own country. For instance, financial aid might have been provided by a developing country through the bachelor's level on the condition that the student return after completing post-graduate work. Obviously, there is a thin line that is being defined, between loyalty and freedom. Scientific and engineering societies have to date not taken as active a role in seeking solutions as they could and should. As already alluded to, training should be compatible to and in compliance with the home environment. Stated in a different way; there must be an intellectual compatability with the enviroment.

A "brain-drain" of a different sort but one that is reaching acute proporations in industrialized countries (but certainly could be applicable to emerging countries) is one of an internal variety. The current pay scale in the secondary schools, and to some extent tertiary education, favours the loss of the classroom teacher (and/or researcher) to industry. This is especially true in the journeyman type of employment such as in programming and computer fields. The need in such fields is great, the pay is commensurate, and the "brain-drain" follows. Thus future generations of students suffer even though there has been no movement of personnel from one

country to another. One country (France) has a partial alleviation in appointing newly trained professionals who wish to enter the academic ranks to foreign posts where the language barrier would not be a problem. After a predetermind number of years this person would be replaced, return to the home country to enter a university. Thus, quality education and research are essentially assured in a developing country that would otherwise lack the qualified staff.

An often-stressed issue by the participants in this context is the importance of instruction in the home country by persons who have lived and worked in the "real world" of the profession in that country. Instructors should be able to teach from experience and not by the book alone. A need is recognized at the upper divison level (perhaps more commonly found in the engineering professions) for properly written materials that are regionally oriented. India was used as a demonstration case where a highly visible and viable engineering programme now exists, but unique in many respects only to India. No one has written texts, laboratory, and/or design materials for a specific geographic or local area. To a degree the same is true of other written materials so badly needed for the local conditions.

3.1.8 Collaboration among nations, international training centres and institutes

Joint programmes at all levels—national, regional, international—and also at all stages of development should be investigated. *National centres could be established starting with regional collaboration but eventually becoming fully national in character.* Still another suggestion was that of *international collaboration such as now exists in the International Latin American Training Centre in Statistics which involves 15 nations.* It was suggested that *visiting teams be sent from industrialized countries to assist in setting up such projects on a temporary basis.* Support eventually would be withdrawn in the international sense when the centres are fully established. Several examples of such collaboration were cited: the Asian Institute of Technology at Bangkok and the proposed practice school programme of Delhi (India), Massachusetts Institute of Technology (USA) and China. It was agreed that associations should not compete with universities but should encourage collaboration. It was also suggested that *associations could identify the areas as well as the methods of research, appropriate to their countries.* Initially such information may be shard between neighbouring countries with similar backgrounds, and be later extended and expanded. Both governmental and non-governmental systems channels should be considered. The former has the limitation that users would obviously be restricted to a specified geographic area. The non-governmental system would be more flexible and probably more productive.

Societies could and should be involved in the pooling of information and expertise successively at the national, regional and international levels. Such a network already exists to some extent for individuals in scientific and engineering professions. There is every reason to believe that a similar informative approach could be made for educationally oriented programmes.

3.1.9. Enlarging and developing human resources; incorporation of both sexes and minority groups in the educational development.

In recruiting suitable personnel, the working group felt that the major principles involved were: (a) motivation, linked to leadership and viewing the problem as a challenge; (b) a relatively short and finite period for a project so that the scientist involved would be realistic about the duration; (c) financial assistance in setting up a governance structure in societies for the purpose of recruitment. It was recommended that *national societies be helped in recruiting human resources for scientific education and training with financial assistance provided for the purpose of setting up a governance structure.* The breadth of this undertaking suggests that *an agency such as UNESCO should be approached.*

3.1.10 Dissemination of educational materials, financial assistance for the emerging countries including problems of copyright.

Several groups already exist that convert teaching materials available in industrialized countries for use in developing countries. One such group is ICSU. A particular local situation might be referred to: NCERT in India which screens materials required for certain local conditions. Several suggestions and recommendations are included: *associations and societies in developing countries should identify the material they need from industrialized countries.* The availability of materials required may also be advertised through such publications. Associations within industrialized countries in collaboration with developing countries should identify the institutions where there are particular needs in developing countries.

3.1.11 Follow-up Action

The critical nature of this last item was recognized. *Scientific and engineering associations that do not have mechanisms for interactions at the international level should do all in their power to establish such.* Several of the representatives in the working group described highly organized International Activities Committees (e.g. the American Chemical Society). There must be continuous communication. For example, the actions taken at or as a result of this seminar must be disseminated. Several mechanisms already exist. The COSTED Newsletter goes to all Academies and could be used. This same organization as well as UNESCO could identify action agents working in turn with the Organizing Committee of this Seminar. *The AAAS Office of International Science could send a questionnaire and collect information from all participants within six months regarding further opinions and options. Later a national consortium of international participants might be arranged.*

It was felt that *the needs of the African countries are sufficiently specific to justify holding a seminar of the "Delhi" type.* The proceedings of this meeting would of course be widely disseminated. *Articles relating to it could be published in the specific journal of the society being represented by the participants. These articles may be further collated as supplementary proceedings.*

3.2 Recommendations

3.2.1 Motivation of youth of both sexes. National and local societies should strive towards encouraging the youth of both sexes and of minority groups to further their education and actively join in professional programmes.

3.2.2 International component. Societies that do not have an international division or component are encouraged to generate such.

3.2.3 Stimulating new societies. It is proposed that national societies in industrialized countries stimulate the establishment of national societies in developing countries to ensure among other efforts that professional continuing education be pursued according to local needs.

3.2.4 Career opportunities in developing countries. Professional societies can provide career guidance and other information to their members to help alleviate the "brain-drain".

3.2.5 Subsidized memberships. Societies of the industrialized countries should seek devices that would permit scientists from developing countries to enjoy the advantages of those societies without cost, or at reduced cost.

3.2.6 International, collaborative institutes. Wherever possible short-term joint education and training institutes on regional or international bases should be established in order to be as cost effective as possible. At some later date as the scientific and engineering communities increase in size, such institutes can be nationalized, moving from an international support basis to a national one.

3.2.7 Definition of local needs. National scientific and engineering societies should help in the definition and identification of regional and local needs. This should be done with the cooperation of the scientists and scientific bodies within the region. It is suggested that societies refrain from establishing a single global approach to training and education.

3.2.8 Follow-up activities concerning this global seminar are necessary:

(a) An earlier group survey made by UNESCO of the local conditions in Africa should be updated and activities initiated to define actions relevant to the local situations in Africa.

(b) The proceedings of this Global Seminar (as well as of any subsequent seminar) should be widely disseminated.

(c) Articles relating to it should be published in the journal of each society represented in New Delhi.

(d) These articles may be later collated in a supplementary proceedings, perhaps in the form of a newsletter.

(e) AAAS should follow-up later actions by the participants and communicate the results.

(f) A Continuing Committee chosen from the participants of the New Delhi Global Seminar should maintain the momentum created.

3.2.9 Continued evaluation of lacal needs. A continuing evaluation of the actual needs in education should be performed by professional societies. It is further recommended that societies create (where none exist) divisions or sections devoted to the development of education.

3.2.10 Training of sub-professionals. There exists a gap of manpower of technicians below the level of technically trained professionals. This gap must be narrowed and this can be done by creating instructional programmes headed by individuals who are skilled in both areas. It is further proposed that attention be given to the continued training of technicians.

3.2.11 Continuing education. Societies should create mechanisms of continuing education that will minimize technical obsolescence, that is programmes of lifelong learning.

3.2.12 Lobbying in education. Societies should create mechanisms (individuals or committees) that will keep surveillance of their governments' legislative actions as they relate to professional education. Where legally possible influence should be brought to bear to achieve improvement.

3.2.13 Education for unique local needs. Training should be compatible with the home or local environment. A means to this end is the scheme of allowing a person from a developing country to share graduate thesise ducation between that country and the industrialized country. Literature and other instructional media should be produced in a locally understood and locally useable form. This end can be achieved by adaptation of the existing literature to the local environment.

3.2.14 Dissemination of subsidized educational material. Societies of the industrialized countries should inform societies in the developing countries on the availability of educational literature. Samples of such should be provided for local adaptation. Proper legal and/or financial means should be sought to solve the copyright problem so as to allow for local reproduction.

3.2.15 Identifying funding sources. It is proposed that efforts be directed towards generating a list or lists of funding organizations that might aid individuals in developing countries, especially, to attend international meetings.

WORKING GROUP 4

Scientific and Technological Planning and Evaluation

Co-Chairmen:	
E H OKSANEN	*Finland*
Y A OVCHINNIKOV	*USSR*
B R RAO	*India*
Rapporteurs:	
J L APPLE	*USA*
V K GAUR	*India*
Participants:	
P A D ALLSOPP	*Guyana*
D ATMOWIDJOJO	*Indonesia*
F BASTARRACHEA	*Mexico*
D BASU	*India*
J S BAWA	*India*
W A BENJELLOUN	*Morocco*
H BROOKS	*USA*
CHANG YIN	*People's Republic of China*
CHEN ZIAO YUAN	*People's Republic of China*
J G COLLINGWOOD	*United Kingdom*
E Q DADDARIO	*USA*
T F MALONE	*USA*
A N D NANAVATI	*India*
J N NANDA	*India*
W F NELSON	*USA*
A T OSPINA	*Colombia*
S M PRIMAKOV	*USSR*
S V ROXAS	*Philippines*
W D SAWYER	*USA*
S SCHWARTZMAN	*Brazil*
V I TKACHENKO	*USSR*
D WAHL	*German Democratic Republic*
D E WINCH	*Australia*
E ZWOYER	*USA*

WORKING GROUP 4

Scientific and Technological Planning and Evaluation

4.0 Scientific and Technological Planning and Evaluation

4.1 Points Emphasized in the Discussion

Most scientific and engineering societies have objectives that further the interests of their members. A major achievement will be that of broadening their scope from the level of objectives related solely to the society to the level of those related to development.

Although scientists and technologists can play an important role in establishing national policy and priorities, the right to exercise this role will undoubtedly have to be earned.

A challenge to societies is the translation of development problems into discrete technical problems. To be carried out effectively this must be done at the local level. For example, given a national objective of improved nutrition, how can the various biological societies organize themselves to identify the specific researchable problems whose solution and application could result in improved nutrition? This is a two-way interaction that should match national goals with the capabilities of existing scientific societies to influence the content of development plans.

Severe problems that constrain research planning in developing countries include:

(a) Lack of material resources;

(b) Inadequate number of qualified professionals;

(c) Lack of confidence in national professionals;

(d) Inadequate participation by national professionals in the planning process;

(e) Relative neglect of the basic sciences;

(f) The tendency toward high visibility projects that may represent short-term solutions.

For example, these problems are manifest in varying degrees in the countries of North Africa. The professional associations there are working toward alleviation of these problems through regional coordination in planning and execution of scientific and technological research. Membership in the association of Moroccan Biologists is open to all disciplines. The Association has been effective in interacting with government by volunteering the services of scientists for specific consultancies. How

can societies in industrialized countries be helpful to the small scientific societies such as those in Morocco?

Scientific societies, especially consortia of related disciplinary societies, have comparative advantages which are valuable in the context of many development initiatives. The societies have less appearance of conflict of interest because they are not competitors for the funding of operational programmes, as would be research institutions of government agencies. However, continued credibility of the work of these societies and consortia is fundamentally dependent on the professional quality of their analyses and recommendations. The societies are not and should not be accountable in a political sense for the programmes they recommend. They can provide inputs to policy, but should not be responsible for establishing policy.

Regarding the initiatives of consortia of societies, e.g., in the field of plant protection; how can these groups assess the adequancy of the proposed efforts to the full scope of the problem? This question arises not only with respect to necessary research, but even more with respect to the necessary scale of application of the research results. The question is not only what kinds of things need to be done to attack a defined problem, but also how much, and on what scale of application activity is required, to make a real dent on the problem.

Scientific societies can have a major impact upon national policy decisions in the industrialized countries. The potential exists for societies in developing countries to play analogous roles. As an example, the American Physical Society has conducted major studies on nuclear reactor safety, the nuclear fuel cycle and redioactive waste disposal, prospects for photovoltaic cells for solar energy development, and opportunities for more energy efficient buildings. All of these reports were endorsed by the elected Council of the Physical Society before they were released, and they have had a considerable influence on national policy. It should be possible for scientific societies to do similar studies in support of national and international development problems.

The planning and evaluation of science and technology programmes must be consistent with political goals and realities. Such programmes must contribute to the national welfare in the eyes of those responsible for planning and implementing development programmes.

The evaluation capability of the scientific and engineering societies is unique and potentially very important for development problems. Examples were cited in the working group where societies had a favorable impact upon science and technology budget development. A number of these examples can be found in the contributed papers.

In order to continue to play the role of programme evaluator and critic, societies must maintain a strong dedication to objectivity and independence from government control. It was pointed out, however, that in some small countries the science community lacks members and stature requisite for that role.

What is the responibility of societies to develop a capability for planning and evaluating programmes? How can they be motivated to assume these roles? It was pointed out that not all members of societies in industrialized countries are motivated

assume these roles and that perhaps even fewer are prone to become involved internationally.

It was also recognized that societies have identified expertise through their membership but that these members are otherwise employed and not subject to society assignment or control except by mutual consent of both individual and employer.

Scientists must demonstrate their value and credibility to government and to the people in order to be instrumental in the programme planning and evaluation processes. Various programme options should be identified and their respective impact upon implementation should be described. It was pointed out that 400–500 scientists were consulted in the course of developing the most recent five-year plan in India.

The political climate is important to the roles of societies in different countries.

Scietific societies may be effective in influencing funding decisions by their national agencies on behalf of overseas projects.

Some national societies now hold national conferences dedicated to specific timely topics. Such conferences could be broadened to embrace science and technology problems on an international basis.

Some engineering societies have an impact on the planning and evaluation process by establishing: (1) codes and standards for construction, (2) curriculum content in professional schools (and actually curriculum accreditation), (3) policy committees for assessment of important development topics with the aim of influencing legislative decisions, and (4) liaison committees that interact with government agencies on a regular basis.

Questions were raised as to whether societies should seek to influence the political process; will they or can they provide alternative plans or strategies, and are they willing to make commitments to these roles? Obviously the larger societies with professional managers may have the resources and continuity to sustain these roles, but it would be very difficult for small societies.

It was indicated that some countries are much more successful in implementing plans than others and that a basic reason is "people's involvement" in the planning process. Thus, the inputs of scientific and engineering societies as integral components of the national planning process should enhance programme implementation. Societies cannot assume the role of national planning commissions but can complement to these bodies by offering opinions on specific topics.

A traditional role for societies is to bestow professional prestige on selected members. In some developing countries, scientists who practise highly sophisticated research with a low technology yield are rewarded whereas others two also practise good science but in pursuit of more pragmatic goals may go unrecognized. Societies should award recognition to both types of endeavour.

4.2 Recommendations

4.2.1. Professional societies in both developing and industrialized countries should extend their goals and interests beyond their traditional functions of publication, information dissemination, and promotion of scientific excellence within their

disciplines. Individually and jointly they should attempt to mobilize their intellectual resources to provide input to national development planning and to the evaluation of national development plans from a technical perspective.

4.2.2. The goal of greater professional society involvement in development can only be realized if there are changes in traditional attitudes and approaches. These include:

(a) Changing the reward structure to give greater recognition to practical contributions and to ingenious adaptation as well as original research.

(b) Forging closer links with industry and with other institutions directly engaged in development or development planning.

(c) Clarifying development objectives and identifying within them critical scientific and technical issues, which could then be attacked by more specialized groups.

(d) Undertaking ad hoc assessment of development plans where success is sensitive to scientific and technical considerations. These assessments must be interdisciplinary and will thus usually require collaboration among societies.

(e) Evaluating government policies and programmes in order to develop greater interaction between development planning and research and development allocations.

4.2.3. Professional societies should become more oriented towards the implications of socio-economic projections as a basis for identifying critical needs for new technologies and highlighting these needs through various communications media. They have a unique role to play in identifying situations where a radical change in technological approach may be essential if projected goals are to be realized.

4.2.4. All evaluations and estimates must take full account of local aspirations and values, as well as social and material constraints, while attempting to distinguish between those values that should be preserved and those that pose fundamental obstacles to development.

4.2.5. Societies in industrialized countries and in the more advanced developing countries can play a catalytic role in accelerating the interaction between the technical community and the development planning and evaluation functions in developing countries. An important secondary benefit will be the familiarization of more scientists and technologists in industrialized countries with the realities of development problems.

4.2.6. Societies in developing countries individually and in collaboration with industrialized country societies must play a role in the assessment of technologies proposed for the implementation of development plans in terms of their wider social and environmental impacts.

CONCLUDING REMARKS

A K SHARMA *Seminar Chairman*

Development has been variously interpreted, but to me it means culture of human values, indigenous human resources for a self-reliant economy, fostering an atmosphere of creative ideas without destroying the beauty of nature or more precisely, the destruction of the natural ecosystem.

The Seminar has been able to focus the immense potential of scientific and professional societies to achieve the above objectives. Ideas have been concretized for the (i) formation of a consortium of scientists at all levels, (ii) methodology for the dissemination of the concept of developments to the masses, (iii) mechanism for utilisation of maximum potential of existing resources, and (iv) involvement of societies in national planning. The flow of information from developed to developing countries and *vice-versa*, one of the essential requirements of development—its mechanism for operation has been worked out. We sincerely hope that these recommendations which would create the requisite impact both at the national and international level would be followed up to the details. The sincerity, urge and initiative evinced in this Seminar representing the cross-section of the scientific community of the world, provide sufficient reasons for optimism of the outcome of this Global Seminar.

In the organisation of the Seminar of this magnitude which is truly Global in nature, the tremendous amount of basic work is needed. This challenge has been met principally by Dr J T Ratchford and his colleagues from the AAAS and Dr S K Dasgupta and Dr J N Nanda on behalf of the Indian counterparts and Dr R D Deshpande, Science Councellor, Indian Embassy, Washington. The able assistance of the entire staff of the Indian National Science Academy who have worked behind the scene is gratefully acknowledged. We owe a great deal to the Chairmen, Rapporteurs, Discussants and Participants who had worked very hard to make the seminar a success. It is indeed a pleasure for me to acknowledge their help. Lastly, I must mention the name of Professor Kenneth E Boulding—the other Chairman of this Seminar—who has been the principal driving force and a source of inspiration of this entire congregation. The friendship and the rapport that be developed, will be an invaluable treasure for me.

JOINT ORGANIZING COMMITTEE

U.S Members

Professor HARVEY BROOKS
Benjamin Peirce Professor of
Technology and Public Policy, Division of
Applied Sciences, Harvard University
Cambridge, Massachusetts 02138
Phone: (617) 495 2831

Dr RENEE C FOX
Annenberg Professor of the Social Sciences
Department of Sociology, 3718 Locust Walk
CR, University of Pennsylvania, Philadelphia
Pa. 19104
Phone: (215) 243-7833

Dr THOMAS F MALONE
Foreign Secretary
National Academy of Sciences
2101 Constitution Avenue, Washington
D.C. 20418
Phone: (202) 389-6226, (317) 283-9421

Dr J THOMAS RATCHFORD
Associate Executive Officer
American Association for the Advancement
of Science, 1776 Massachusetts Ave., N.W.
Washington, D.C. 20036
Phone: (202) 467-4310

Professor WILLIAM M SANGSTER
Dean, College of Engineering
Georgia Institute of Technology, Atlanta
Georgia 30332
Phone: (404) 894-3350

Dr WILLIAM D SAWYER
Dean, School of Medicine
Wright State University, P.O. Box 927
Dayton, OH 45401
Phone: (513) 873-2933

AAAS Staff:

Ms DENISE WEINER
Program Associate
Office of International Science, AAAS
1776 Massachusetts Ave., N.W.
Washington D.C. 20036
Phone: (202) 467-5230

India Members

Professor D BASU
Director
Indian Association for Cultivation of Science
General Secretary, Indian Science Congress
Association, 14 Dr Biresh Guha Street
Calcutta 700017

Dr S K DASGUPTA
Executive Secretary
Indian Science Congress Association
14 Dr Biresh Guha Street, Calcutta 700017

Professor M G K MENON
Secretary
Department of Science and Technology
Technology Bhawan, New Mehrauli Road
New Delhi 117029

Dr J N NANDA
Executive Secretary
Indian National Science Academy
Bahadur Shah Zafar Marg
New Delhi 110002

Professor V RAMALINGASWAMI
President
Indian National Science Academy
Bahadur Shah Zafar Marg, New Delhi 110002

Professor B RAMACHANDRA RAO
Vice Chairman
University Grants Commission
Treasurer
Indian National Science Academy
Bahadur Shah Zafar Marg, New Delhi 110002

Professor A K SHARMA
President
Indian Science Congress Association
14 Dr Biresh Guha Street
Calcutta 700017

PARTICIPANTS

	REPRESENTING
ARGENTINA	
Dr ANGEL YADAROLA President, Comite UPADI de Ensenanza de Ingenieria Mariano Moreno 435, 5000 Cordoba	**Union Panamericana de Asociationes de Ingenieros**
AUSTRALIA	
Dr EDWARD F WHEELER Executive Editor, Search, ANZAAS, P. O. Box 873 Sydney, NSW 2001	*Australia/New Zealand* **Association for the Advancement of Science**
Professor DENIS EDWIN WINCH Dept. of Applied Mathematics, University of Sydney Sydney, N.S.W. 2006	*Australia/New Zealand* **Association for the Advancement of Science**
BANGLADESH	
Professor MOFIZUDDIN AHMED Bangladesh Association for the Advancement of Science c/o Dept. of Chemistry, Dacca University, Dacca-2	**Bangladesh Association for the Advance of Science**
BRAZIL	
Dr OSCAR SALA Past President Brazilian Society for the Progress of Science, Institute de Fisica, Univ. de Soa Paulo Caixa Postal 20516 01000 Sao Paulo	**Brazilian Society for the Progress of Science**
Professor SIMON SCHWARTZMAN Instituto Univ. de Pesquisas de Rio de Janeiro (IUPERJ) Rua da Matriz, 82 22260 Botafogo Rio de Janeiro	**Institute Universitario de Pesquisas de Rio de Janeiro**
CANADA	
Professor J WILLIAM McGOWAN Department of Physics, University of Western Ontario London, Ontario, N6A 3R7	**American Physical Society**
CHILE	
Professor IGOR SAAVEDRA Dept. of Physics, University of Chile Casilla 5487, Santiago	**Chilean Academy of Science**

PEOPLE'S REPUBLIC OF CHINA

Mr CHANG YIN Engineer, Ministry of Agricultural Machinery of People's Republic of China, Beijing	China Association for Science and Technology
Mr CHEN XIAO YUAN Deputy Director of Research Department China Association for Science and Technology, Beijing	China Association for Science and Technology
Mr MA JI Council Member, Chinese Society of Agricultural Machinery, No. 1 Beishatan, Deshengmen Wai, Beijing	Chinese Society of Agricultural Machinery and China Association for Science and Technology
Mr TAN DU Secretary General, Sichuan Mechanical Engineering Society, 202 Renmin Road Southern, Chendu, Sichuan	Sichuan Mechanical Engineering Society and China Association for Science and Technology
Mr WU JINCHENG Chemical Industrial and Engineering Society of China P. O. Box 911, Beijing	Chemical Industrial and Engineering Society of China and China Association for Science and Technology
Mr ZHANG WENQI President, Beijing University of Iron and Steel Technology, Beijing	China Association for Science and Technology and the Chinese Society of Corrosion and Protecution

COLOMBIA

Dr ALBERTO T OSPINA Past President, Asociacion Colombiana para el Avance de la Ciencia, Calle 70 No. 9-32 Bogota 2	Asociación Colombiana para el Avance de la Ciencia

COSTA RICA

Dr RODRIGO ZELEDON President, Consejo Nacional de Investigaciones Cientificas y Tecnologicas, Apartado 10318, San Jose	Consejo Nacional de Investigaciones Cientificas y Tecnologicas

EGYPT

Dr HAMED AHMED KADDAH President, Egyptian Society of Consulting Engineers 13, Sh. Antikhana, Cairo	Egyptain Society of Consulting Engineers

FINLAND

Dr ERKKI H OKSANEN Finnish Association of Agricultural Engineering Meikonkatu 16 A, POB 28, SF-00211 Helsinki 21	Finnish Association of Agricultural Engineering

FRANCE

Professor ROBERT GUILLAUMONT
Laboratoire de Radiochimie
Institut de Physique Nucleaire
Universite de Paris-Sud, BP1, 91406 Orsay Cedex

Societe Chimique de France

FEDERAL REPUBLIC OF GERMANY

Mr HARALD C BOSTROM
International Relations, Verein Deutscher Ingenieure
Postfasch 1139, D-4000 Dusseldorf 1

Verein Deutscher Ingenieure

Dr JORG DEBELIUS
Deutscher Verband Technisch-Wissenschaftlicher Vereine, Graf-Recke-Str/84, 4000 Dusseldorf 1

Deutscher Verband Technisch-Wissenschaftlicher Vereine

GERMAN DEMOCRATIC REPUBLIC

Professor DIETRICH WAHL
Institute of Theory History, c/o Academy of Sciences of the German Democratic Republic, Berlin

Academy of Sciences of the German Democratic Republic

GUYANA

Mr P A D ALLSOPP
President, Guyana Association of Professional Engineers, P.O. Box 95, Georgetown

Guyana Association of Professional Engineers

HUNGARY

Miss KATALIN HAJOS
Dept. of International Relations, Hungarian Academy of Sciences, 1361 Budapest

Hungarian Academy of Sciences

Professor KAROLY POLINSZKY
Member and Vice-President, Hungarian Academy of Sciences, Professor of the Chair of Chemical Technology Polytechnical, University, Budapest H-1051 Roosevelt ter 9

Hungarian Academy of Sciences

INDIA

Professor D BASU
President, Asiatic Society, 1 Park Street
Calcutta 700016

Asiatic Society

Lt GENERAL JASBIR SINGH BAWA
Immediate Past President, The Institution of Engineers
301 RPS Flats, Sheikh Sarai, New Delhi 110017

The Institution of Engineers

Lt GENERAL M S. BANGA
The Institution of Engineers, 8 Gokhale Road
Calcutta 700020

The Institution of Engineers

Professor P K BOSE Department of Statistics, Calcutta University, Calcutta	Indian Science News Association
Dr S K DASGUPTA Executive Secretary, Indian Science Congress Association 14 Dr Biresh Guha Street, Calcutta 700017	Indian Science Congress Association
Professor V P GAUR Dept. of Geology & Geophysics, Dean of Research Roorkee University, Roorkee 247672	(Rapporteur)
Dr HARISH GROVER Honorary Joint Secretary Indian Medical Association, I.M.A. House Indraprastha Marg, New Delhi 110002	Indian Medical Association
Professor V P GUPTA Indian Society of Genetics & Plant Breeding, New Delhi	Indian Society of Genetics and Plant Breeding
Professor M G K MENON Secretary, Department of Science and Technology Technology Bhawan, New Mehrauli Road, New Delhi 110029	(Plenary Speaker)
Dr A P MITRA Deputy Director, National Physical Laboratory Hillside Road, New Delhi 110012	(Rapporteur)
Professor C R MITRA Director, Birla Institute of Technology and Science (BITS), Pilani 333031, Rajasthan	Birla Institute of Technology and Science
Professor Y S MURTY Professor and Head Botany Department Meerut University, Meerut, U.P.	Indian Botanical Society
Shri B T NAGRANI Secretary and Director General The Institution of Engineers, 8 Gokhale Road Calcutta 700020	The Institution of Engineers
Dr A N D NANAVATI Honorary Secretary, Bombay Natural History Society Hornbill House, Shahid Bhagat Singh Road Bombay 400023	Bombay Natural History Society
Dr J N NANDA Executive Secretary, Indian National Science Academy Bahadur Shah Zafar Marg, New Delhi 110002	Indian National Science Academy

Dr Y NAYUDAMMA Central Leather Research Institute, Madras 600020	(Plenary Speaker)
Dr S C PANDEYA Head, Dept. of Biosciences, Saurashtra University Kalavad Road, Post Bag No. 9, Rajkot, Gujarat	(Rapporteur)
Shri S G RAMACHANDRA President, The Institution of Engineers Executive Vice President, Kirloskar Electric Co. Ltd. Bangalore 560003	The Institution of Engineers
Professor V RAMALINGASWAMI President, Indian National Science Academy Bahadur Shah Zafar Marg, New Delhi 110002	Indian National Science Academy
Professor B RAMACHANDRA RAO Vice Chairman, University Grants Commission and Treasurer, INSA, Bahadur Shah Zafar Marg New Delhi 110002	Indian National Science Academy
Professor C N R RAO Solid State and Structural Chemistry Unit Indian Institute of Science, Bangalore 560012	International Union of Pure and Applied Chemistry
Professor A K SHARMA President, Indian Science Congress Association 14 Dr Bireeh Guha Street, Calcutta 700017	Indian Science Congress Association
Professor (Mrs) ARCHANA SHARMA Head, Dept. of Botany, Calcutta University 35 Ballygunj Circular Road, Calcutta 700019	(Rapporteur)
Dr BIKASH SINHA General Secretary, Indian Physics Association Tata Institute of Fundamental Research, Colaba Bombay 400085	Indian Physics Association
Dr M S SWAMINATHAN Member, Planning Commission, Yojana Bhavan New Delhi 110001	(Plenary Speaker)
Dr S VARDARAJAN Chairman and Managing Director Indian Petrochemicals Corporation Ltd., Baroda	Indian Academy of Sciences
INDONESIA	
Mr DJOEWITO ATMOWIDJOJO Lembaga Ilmu Pengetahuan Indonesia LIPI CISITU, Bandung	National Institute for Metallurgy LIPI

IVORY COAST

Professor ALASSANE SALIF N'DIAYE
Faculty of Science, University of Abidjan, 04 B.P. 322
04 Abidjan

Scientific Association of Ivory Coast

MALAYSIA

Dr M MOHINDER SINGH
c/o Rubber Research Institute of Malaysia
P.O. Box 150, Kuala Lumpur

Malaysian Scientific Association

MEXICO

Dr FERNANDO BASTARRACHEA
Professor, Dept. de Biologia Molecular, Instituto de Invest Biomedicas Univ. Nacional Autonoma de Mexico
Apdo. Postal 70228, Mexico 20

Asociation Mexicana de Microbiologia

MOROCCO

Dr WAIL BENJELLOUN
Associate Professor, Dept. of Biology, Faculty of Sciences
Mohammed V University, Rabat

Association of Moroccan Biologists

NETHERLANDS

Dr J F ARENS
c/o The Royal Dutch Chemical Society
Burnierstraat 1, The Hague

Royal Dutch Chemical Society

PHILIPPINES

Mr SEGUNDO V ROXAS
Deputy Minister, National Science Development Board
Bicutan-Taguig, P.O. Box 3596, Manila

National Science Development Board

POLAND

Dr BOGODAR WINID
Professor of Cartography, Warsaw University, Warsaw

Polish Geographical Society

RUMANIA

Professor MIHAI DRAGANESCU
Director General
Central Institute of Management and Informatics
Blvd. Miciurin No. 8-10 OF. Postal 1, Box 814, Bucharest

Central Institute for Management and Informatics, Rumanian Academy of Sciences

SAUDI ARABIA

Dr ABDUL AZIZ ABUZINADA
Dept. of Botany, Riyadh University, Riyadh

Saudi Biological Society

SINGAPORE

Dr R S BHATAL
Secretary, Singapore National Academy of Science
c/o Singapore Science Centre, Science Centre Road
Jurong, 2260

Singapore National Academy of Science

SRI LANKA

Dr J N OLEAP FERNANDO
Senior Lecturer, Physical Chemistry
University of Colombo, P.O. Box 1490, Colombo 3

Sri Lanka Association for the Advancement of Science
The Institute of Chemistry, and the Royal Society of Chemistry (Sri Lanka Section)

TANZANIA

Dr A S MAWENYA
Dean, Faculty of Engineering, University of Dar-es-Salam
P.O. Box 35131, Dar-es-Salam

Institution of Engineers,

THAILAND

Professor KAMCHORN MANUNAPICHU
Dept. of Chemistry, Faculty of Science, Mahidol University
Rama VI Road, Bangkok 4

Science Society of Thailand

USSR

Dr EVGENIJ GRISHIN
c/o Mr V K Dobroselksi
Academy of Sciences of the USSR
Foreign Relations Department, Moscow V-71
Leninski Prospect 14

Academy of Sciences of the USSR

Professor G G KOTOVSKY
Head, South Asian Countries Division
Institute of Oriental Studies, c/o Mr V K Dobroselksi
Academy of Sciences of the USSR
Foreign Relations Department, Moscow V-71
Leninski Prospect 14

Academy of Sciences of the USSR

Dr T V MARCHENKO
c/o Mr V K Dobroselski
Academy of Sciences of the USSR
Foreign Relations Department, Moscow V-71
Leninski Prospect 14

Academy of Sciences of the USSR

Academician Y A OVCHINNIKOV
c/o Mr V K Dubroselki
Academy of Sciences of the USSR
Foreign Relations Department, Moscow V-71
Leninski Prospect 14

Academy of Sciences of the USSR

Academician S M PRIMAKOV
Director, c/o Mr V K Dobroselski
Academy of Sciences of the USSR
Foreign Relations Department, Moscow V-71
Leninski Prospect 14

Academy of Sciences of the USSR

Academician C E SEVERIN Dept. of Biochemistry, School of Biology Moscow State University, 117234 Moscow B-234	All-Union Biochemical Society of the USSR, 34 Vavilov Street, Moscow 117312
Professor L N SYMAROKOV c/o Mr V K Dobroselski Academy of Sciences of the USSR Foreign Relations Department, Moscow V-71 Leninski Prospect 14	Academy of Sciences of the
Mr V I TKACHENKO c/o Mr V K Dobroselski Academy of Sciences of the USSR Foreign Relations Department, Moscow V-71 Leninski Prospect 14	Academy of Sciences of the USSR

UNITED KINGDOM

Dr LOUIS COHEN Executive Secretary, The Institute of Physics 47 Belgrave Square, London SW1X 8QX	The Institute of Physics
Dr JOHN G COLLINGWOOD Vice President and General Secretary British Association for the Advancement of Science Fortress House, 23 Savile Row, London W1X 1AB	British Association for the Advancement of Science
Dr DAVID W MORLEY Deputy Secretary British Association for the Advancement of Science Fortress House, 23 Savile Row, London W1X 1AB	British Association for the Advancement of Science

USA

Dr J LAWRENCE APPLE Director, International Programmes in Agriculture School of Agricultural and Life Sciences North Carolina State University, Raleigh, NC 27607	American Phytopathological Society
Dr KENNETH E BOULDING Institute of Behavioral Science, University of Colorado Boulder, Co. 80309	American Association for the Advancement of Science
Professor ROBERT C BRASTED Dept. of Chemistry, University of Minnesota 207, Pleasant Street, S.E., Minneapolis, MN 55455	American Chemical Society
Professor HARVEY BROOKS Benjamin Peirce Professor of Technology & Public Policy Division of Applied Sciences, 226 Aiken Computation Lab Harvard University, Cambridge, Massachusetts 02138	American Association for the Advancement of Science

Professor CHARLES L COONEY Assoc. Prof. of Biochemical Engineering Dept. of Nutrition and Food Science Massachusetts Institute of Technology, Cambridge Ma. 02139	American Society for Microbiology
Mr EMILIO Q DADDARIO c/o Office of International Science Amer. Associ for the Advan. of Science 1776 Massachusetts Avenue, N.W. Washington, DC 20036	American Association for the Advancement of Science
Dr GEORGE A DOUMANI Vice President for Technology Transfer Human Resources Management, Inc., 1101 30th Street N.W., Suite 301, Washington, D.C. 20007	Human Resources Management Inc.
Mr OCTAVE DU TEMPLE Executive Director, American Nuclear Society 555 North Kensington Avenue, LaGrange Park Illinois 60525	American Nuclear Society
Professor MERLE L ESMAY Dept. of Agricultural Engineering Michigan State University, East Lansing, Michigan 48824	American Society of Agricultural Engineers
Professor NANCIE L GONZALEZ Dept. of Anthropology, University of Maryland College Park, Md. 20742	American Anthropological Association, Society for Applied Anthropology, and American Association for the Advancement of Science
Dr STEPHEN KAHNE Division Director, Electrical, Computer & Systems Engin. National Science Foundation, 1800 G Street, N.W. Washington, D.C. 20550 Permanent Address Chairman, Systems Engineering Case Institute of Technology Case Western Reserve University Cleveland, Ohio 44106	Institute of Electrical and Electronics Engineers
Dr JUNE L KELSAY Research Nutritionist, Carbohydrate Nutrition Laboratory Beltsville Human Nutrition Research Centre Science and Education Administration U S Department of Agriculture, Beltsville, Md. 20705	American Institute of Nutrition
Dr FRED C LEONE Executive Director, American Statistical Association 806 15th Street, N.W., Washington, D.C. 20005	American Statistical Association

Dr THOMAS F MALONE Foreign Secretary, National Academy of Sciences 2101 Constitution Avenue, Washington, D.C. 20418	US National Academy of Sciences
Dr WILLIAM F NELSON Director, Advanced Technology Lab., GTE Labs. Inc. 40 Sylvan Road, Waltham, MA 02154	Advanced Technology Laboratory
Dr J THOMAS RATCHFORD Associate Executive Officer American Association for the Advancement of Science 1776 Mass. Ave., N.W., Washington, D.C. 20036	American Association for the Advancement of Science
Dr WILLIAM M SANGSTER Dean, College of Engineering Georgia Institute of Technology, Atlanta, Ga. 30332	American Association of Engineering Societies
Dr WILLIAM D SAWYER, Dean, School of Medicine, Wright State University P.O. Box 927, Dayton, Ohio 45435	American Society for Microbiology
Dr MOHAN K WALI Director and Professor of Biology, Project Reclamation Box 8122, University Station, Grand Forks North Dakota 58202	Ecological Society of America
Dr DOROTHY ZINBERG Science and International Affairs Kennedy School of Government, Harvard University 79 Boylston Street, Cambridge, Mass. 02138	American Sociological Association and American Association for the Advancement of Science
Dr EUGENE ZWOYER Executive Director, American Society of Civil Engineers 345 East 47th Street, New York, New York 10017	American Society of Civil Engineers
VENEZUELA	
Dr MARCEL ROCHE Editor-in-Chief, Interciencia, Apartado 51842, Caracas 105	Interciencia Association

ADDENDUM

The following participants could not attend the Global Seminar due to circumstances beyond their control

Name and Address	*Representing*
Dr J O AMOSU Department of Plant Science, University of Ife Ile-Ife, Nigeria	Science Association of Nigeria
Professor OZDEM ANG Secretary General, Turkish Microbiological Society P.K. 57 Beyazit, Istanbul, Turkey	Turkish Microbiological Society
Professor OLUMUYIWA AWE Honorary President, Science Association of Nigeria c/o Department of Physics, University of Ibadan Ibadan, Nigeria	Science Association of Nigeria and West African Science Association
Dr JOHN M HYDE Department of Mathematics, University of Ghana P.O. Box 62, Legon, Ghana	West African Science Association
Professor KOSSI KEKEH Association Togolaise de la Recherche Scientifique B.P. 2240, Lome, Togo	Association Togolaise de la Recherche Scientifique
Dr JOHN M WERE President, Uganda Geographical Association Department of Geography, Makerere University P.O. Box 7062, Kampala, Uganda	Uganda Geographical Association

OBSERVERS

Mr ASAF ZAKI AHMAD
System Engineer, Computer Services
Department, Engineers India Ltd.
26 Kasturba Gandhi Marg, New Delhi, India

Dr M ANANDAKRISHNAN
Chief, New Technologies Section
U.N. Centre for Science and Technology for
Development, Room DC-1044, 1 U.N. Plaza
New York, New York 10017, USA

Professor R P BAMBAH
Department of Mathematics
Centre of Advanced Studies in Mathematics
Punjab University, Chandigarh - 160014, India

Dr MANFRED CZRESLA
Division of International Programs
National Science Foundation, 1800 G Street
N.W., Washington, D.C. 30550, USA

Dr R D DESHPANDE
Science Counsellor, Embassy of India
2107 Massachusetts Ave., N.W., Washington
D.C. 20008, USA

Dr J S KANWAR
President
International Society of Soil Science
c/o ICRISAT . Patacheru P.O., Hyderabad
A.P. 502324, India

Mr RUSTAM LALKAKA
Deputy Director
Interim Fund for Science and Technology
U.N.D.P., United Nations Plaza
New York, New York 10017, USA

Dr SHRIKANT D LIMAYE
AGID Counsellor in India
c/o The Geophysical Explorers
New 1443 Shukrawar Peth, Bajirao Road
Poona 411002, India

Professor J L MONGAR
Dept. of Pharmacology, University College
London, United Kingdom

Dr P S NAGPAL
Scientist, Centre for Study of Science and
Technology Development, CSIR Complex
Hill Side Road, New Delhi-110012, India

Dr HERMAN POLLACK
Graduate Program in Science, Technology
and Public Policy
George Washington University
University Library, Room 714, 2130 H Street
N.W., Washington, D.C. 20052, USA

Dr S RADHAKRISHNA
Scientific Secretary COSTED, Dept. of Physics
Indian Institute of Technology
Madras-600,036, India

Professor H Y MOHAN RAM
Professor of Botany, University of Delhi
Delhi-110007, India

Dr BEAT SITTER
Secretary-General
Schweizerische Naturforschende Gesellschaft
Hirschengraben 11, Postfach 2535, 3001 Bern
Switzerland

Dr ROBERT STELLA
Science Counsellor, U S Embassy, New Delhi
India

Dr J R TATA
Head
Laboratory of Developmental Biochemistry
National Institute for Medical Research
Mill Hill, London, United Kingdom

Professor S K TREHAN
Mathematics Department, Punjab University
Chandigarh 160014, India

Dr M VANNUCCI
Program Specialist
UNESCO Regional Office of Science and
Technology for South and Central Asia
40-B Lodi Estate, New Delhi 110003, India

Professor A R VERMA
Director, National Physical Laboratory
Hill Side Road, New Delhi-110012, India

SCIENTIFIC AND ENGINEERING SOCIETIES REPRESENTED

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Societe Chimique de France
250 rue Saint-Jacques, 75005 Paris
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Postfach 20 50 04, D 5300 Bonn 2
Federal Republic of Germany

Verein Deutscher Ingenjure (VDI)
Postfach 1139, D 4000 Dusseldorf 1
Federal Republic of Germany

Hungarian Academy of Sciences
Budapest, Hungary

The Royal Netherlands Chemical Society
Postbus 90613, 2509 LP The Hague
The Netherlands

Academy of Sciences of the USSR
Moscow V-71, Leninski Prospect 14
USSR

The Institute of Physics
47 Belgrave Square
London SW1X 8 QX
United Kingdom

American Association of Engineering Societies
345 East 47th Street
New York, New York 10017