# Pugwash Interest in Communications

Interest of the Pugwash Conferences in a worldwide scientific information system is generating results.

Bentley Glass

The Pugwash Conferences on Science and World Affairs (P-COSWA) began in 1957, just a decade ago. Their chief objective from the outset has been to bring scientists of East and West together in order to consider objectively the perils to the world of nuclear weapons and to pave the way toward complete and universal disarmament as the only sure way to avoid the destruction of civilization. Those scientists—social scientists as well as natural scientists—who have participated in the 17 conferences held to date have thus been primarily concerned with the roads to disarmament and with the establishment of the conditions for maintaining a just and durable peace, once disarmament has been achieved. Nevertheless, it quickly became apparent that many subsidiary concerns were important to the main problem. The settlement of international political claims is a precondition for the reduction of those international tensions that prevent our taking the first steps toward disarmament. The mounting needs of the poorer and less developed countries of the earth, with their teeming populations, constitute a future danger to the maintenance of world order, and the diffusion of general well-being seems necessary to a permanent peace. International scientific cooperation not only can set an example of friendly relations and mutual interdependence, but also can lay a basis for the assistance in education and technology which the more developed nations can supply to underdeveloped countries.

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## The First Pugwash Conference

Even from the First Pugwash Conference, held in that tiny village of Nova Scotia in July of 1957, it was thus recognized that problems of scientific cooperation are relevant to the long-term survival of the human species. Committee Three, on the Responsibilities of Scientists, had in its summary report such ringing statements as the following:

"With the penetration of science into the world of atomic nuclei, humanity has entered a new epoch. The development of science and technology has paramount importance for the future of all mankind. . . . If the achievements of science are rationally employed, they could enormously increase the well-being of all men. Scientific and technical progress is irreversible. . . . The developments of science and technology tend to break down barriers between nations and, in effect, to unify mankind. . . . Science has a well-proven tradition of international cooperation. We hope that this cooperation can be strengthened and extended into other fields of human endeavor. Science develops most effectively when it is free from interference by any dogma imposed from the outside, and permitted to question all postulates, including her own. Without this freedom of scientific thought, and the freedom to exchange information and ideas, full utilization of the constructive possibilities of science will not be possible" (*1*, pp. 84–85).

## The Stowe Conference

The concern with the freedom to exchange scientific information which was thus expressed at the outset of the Pugwash Conferences on Science and World Affairs was reiterated in the statement issued after the third meeting, held in Austria in 1958; but no specific reference was made to the treatment of problems of scientific information at that date. That subject came to the fore in the first of two conferences held at Stowe, Vermont, in the stormy political atmosphere of September 1961, just following the announcement of the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R. Fortunately for the success of these two conferences, the first of them was scheduled to be devoted to the general theme of "International Cooperation in Pure and Applied Science," while the second was to be directed to further discussions of disarmament and the avoidance of nuclear war. It seemed to many of us participants that had it not been for the fruitful and relatively pacific discussions of the first week, the Conferences would have ended in a quick-tempered explosion followed by withdrawal of the delegates from the Eastern countries. Instead, emotions were allayed and many suggestions for international cooperation were made. These were quickly relayed to President Kennedy through his science adviser, Jerome Wiesner, and provided suggestions for the President's address to the United Nations in late September, when he proposed increased international cooperation in science and technological aid to underdeveloped countries as a growing basis for international understanding and peaceful relations.

Among the topics discussed at the Stowe Conference was the exchange of scientists and scientific information. The recommendations on the subject of scientific information were as follows:

"Noting the obstacle to the exchange of scientific information presented by the mounting volume of current publication, which is increasing exponentially and doubling about every decade, we feel that the situation calls for radical measures of rationalization to be designed and carried out through international agreement and cooperation. Among potentially useful measures are the following: to review and co-ordinate the character and content of journals published in all countries with a view to reducing the number and variety of journals which a scientist must follow to keep abreast of work in his discipline; to institute standard formats for the presentation of scientific papers; to formulate a standard system for the annotation of the contents of published papers suitable for coding and manipulation by

machines for the storage and retrieval of information; to institute regional depots under international coordination to store complete experimental records and other documentation in support of the brief published papers; to make such material rapidly available to interested scientists; to consolidate the abstracting services now carried on independently in many countries, a measure that could reduce present duplication of effort by a conservatively estimated factor of three.

"We recommend that measures be taken to bring significant work going forward in all countries to the attention of interested scientists. This objective could be served by the publication of international review journals of two types: interdisciplinary review journals written in relatively non-technical language for the benefit of scientists in different disciplines, and more specialized review journals which would keep scientists working in a given area abreast of the work going on in the same or related areas all over the world.

"We urge that all governments open their postal systems to the untrammelled flow of scientific publications whatever their country of origin or destination" (*1*, p. 121).

Two of the papers prepared by members of the Working Group as background for the discussion were later revised and published in the *Bulletin of the Atomic Scientists* in October 1962 (*2*).

It is significant that of the eight specific recommendations made by the Stowe Conference regarding the improvement of scientific information, not a single one has been fully developed by coordinated international action. Some effort has been expended by the ICSU Abstracting Board to coordinate abstracting services. New review journals, both interdisciplinary and specialized, have been founded. Publication in abbreviated form and storage of the experimental data and documentation have been tried out tentatively. In all respects, however, there has been only piecemeal activity, nearly always of a limited national rather than international scope.

One finds little further discussion of these problems in Pugwash conferences until the Pugwash-COSWA meeting held in Udaipur, India, in January–February 1964. There, in considering the problems of science and technology in developing countries, it was noted that these countries "have experienced great difficulties in obtaining trustworthy and sufficiently complete technical information on industrial processes and the design of machinery and plants for industry." A recommendation was made that the United Nations and its specialized agencies do much more toward "developing industrial consulting services, reference collections of technological information, and a central exchange to publicize the needs in developing countries for specific technical and industrial knowledge" (*1*, p. 169).

## The Karlovy Vary Conference

The Thirteenth Pugwash Conference on Science and World Affairs was held in Karlovy Vary, Czechoslovakia, in September 1964. At that time, following discussion of new papers on the subject by M. M. Dubinin (*3*) of the Soviet Union and Bentley Glass (*4*) of the United States, a much more specific recommendation was made respecting the development of an international system of scientific information along modern technical lines. The recommendation reads as follows:

"Steps should be taken to develop a co-ordinated and unified system of scientific information storage and retrieval. New methods based on modern computer techniques are essential. At the moment in many disciplines new publications accumulate so fast that scientists are not made rapidly aware of much of the published information bearing on their work and there is a resultant duplication of effort in research. The matter is urgent because different systems are being established in different disciplines which are not compatible with one another, like the different systems of weights and measures. It is to be emphasized that such a co-ordinated world-wide system would require the active participation of scientists on a great scale. Appropriate studies should be initiated without delay under the auspices of U.N.E.S.C.O. or I.C.S.U." (*1*, p. 175).

At this Karlovy Vary Conference, Working Group 5 addressed itself to a consideration of "Aims and Methods for Peaceful Collaboration among Nations." The report of the Working Group is printed in the privately circulated *Proceedings of the Thirteenth Pugwash Conference on Science and World Affairs*. Unlike the public statement issued by the Pugwash Continuing Committee that organizes the Conferences, the Proceedings of P-COSWA Conferences have never been distributed beyond the participants in the Conferences, the governments of the countries represented, and international organizations such as the United Nations and UNESCO. The *Proceedings* contain an interesting section devoted to a proposal to establish a World Center of Scientific Information. It is to be understood that this recommendation represents only the views of the members of Working Group 5 and carries no specific endorsement of the entire Conference, such being the general practice of the Pugwash Conferences in respect to all reports and recommendations of Working Groups. The report of Working Group 5 may, however, be reprinted without special permission. This section reads as follows:

*"World Centre of Scientific Information (W.C.S.I.).*

"The proliferation of scientific literature raises one of the greatest obstacles facing the efficient advancement of science today. Particularly in some disciplines, exponential growth of the literature is rapidly producing chaos and unnecessary duplication of effort. Scientists are unable to become aware of, and make use of, much of the scientific information relevant to their own researches. The scientific community has evolved like an organism with a quite inadequate central nervous system for storage and utilization of information. An urgent need has arisen for the development of a world-wide, systematic, co-ordinated and, as far as possible, integrated effort to store and retrieve scientific information. The existing abstracting services and systems for machine coding and indexing cover limited areas of scientific information; they are being developed independently so that information stored in one of them is not freely exchangeable with that in others.

"More than simple unification and co-operation of the existing systems is needed. New systems will have to be developed to cover fields of science where none yet exist. An active programme of experiment, trial and investigation of new methods will have to be undertaken. The systems of storage and retrieval should not be permitted to freeze at present levels of operation.

"In addition to mechanical and technical systems permitting formal classification of new papers by subject matter, and the storage and retrieval of this information, systems will be needed permitting critical analysis as well as the

abstraction of the content of these papers, and this will require the active co-operation of many members of the scientific community all over the world.

"Radical developments in the methods of scientific publication may have to be considered to make possible a rational utilization of scientific information, such as publication on microcards or microfilm instead of journals of the present type. Eventually an international centre should be supplied with comprehensive reports of all scientific work for storage and dissemination to interested workers, together with briefer accounts to be utilized in content analysis storage and retrieval of information.

"We recommend that work be initiated without delay towards developing a unified and co-ordinated system of scientific information storage and retrieval from the heterogeneous and limited beginnings that now exist.

"We suggest that the co-ordination and unification of such systems should be advanced by carefully phased steps which might lead ultimately to establishing a World Centre for Scientific Information (W.C.S.I.). These steps should be the subject of planning by experts in information theory, communications and other scientific fields.

"We recommend that a study group be established under appropriate auspices, such as U.N.E.S.C.O. or I.C.S.U., to undertake this task. Early steps are important if the solidification of different systems, which would render very difficult future international co-ordination and unification, is to be prevented" (*5*).

It is to be noted that the two papers which were written by participants of the Working Group, and which deal specifically with problems of scientific information storage and retrieval, were written not by technical experts on the subject but respectively by a chemist and a biologist. These scientists point out emphatically the needs and some of the difficulties but do not undertake to provide technical solutions. That restriction is characteristic of the Pugwash Conferences and their recommendations in general. They focus the attention of scientists on needed action, but the Conferences themselves and the Continuing Committee which organizes them are not operating agencies that might develop and carry through to completion any recommended plans or programs. They are limited to recognition of needs and to stimulation to act on the part of operating agencies such as scientific centers and bureaus, or national and international organizations. The lack of implementation of the recommendations made by the Pugwash Conferences and Working Group is a real difficulty, the responsibility for which must be laid properly at the doorstep of the governmental and international agencies. Nevertheless, it must be admitted that a wider circulation of the recommendations among social and natural scientists and exertion of more pressure upon the operating agencies by the world of science and by public opinion would be very advantageous.

## Subsequent Attention

The Fourteenth Pugwash Conference was held in Venice, Italy, in April 1965. Once again the issue of scientific information was raised and discussed. The new recommendation reads as follows:

"The Group discussed the problem of storage, retrieval and analysis of scientific data, and noted the interest of the International Council of Scientific Unions (I.C.S.U.) and U.N.E.S.C.O. in the field. It made several recommendations to these groups, including the establishment of an international code of practice for the publication of scientific papers and abstracts, a unified international system for coding the contents of scientific publications, and the elimination of wasteful duplication of abstracting efforts in different countries. The Group hoped that initial co-ordination will pave the way to the creation of an international centre of scientific information. The activities in this field should include not only collection of data, but also their analysis and presentation, much of which can be now done by computers, and the preparation of compendia" (*1*, p. 180).

In addition to this reemphasis on the recommendations of the preceding year, a new working group focused attention upon the obsolescence of science education and the consequent need for frequent curriculum revision and retraining of science teachers as steps to cope with professional obsolescence. International cooperation in science education would obviously be materially aided by the existence of an adequate system of scientific information storage, retrieval, and analysis. Effective scientific training in the future must rest on a solid basis of readily retrievable and analyzable scientific information. The next succeeding Pugwash Conference on Science and World Affairs, held in Addis Ababa in December 1965–January 1966, placed a major emphasis on the needs in science education of the developing countries and did not devote specific attention to scientific information problems.

The most recently held Pugwash Conference was the Seventeenth. It was held at Ronneby, Sweden, in September of 1967. At this conference, Working Group 4 addressed itself to the area of "International Programs in Science." After looking at developments in this area since the Conference at Stowe in 1961, the Group felt that progress had been made in specific international scientific cooperation in such fields as theoretical physics, notably by the successful establishment of the International Center for Theoretical Physics in Trieste, the operation of the International Geophysical Year, and the initiation of the International Biological Program (*6*). On the other hand, no step had been taken in the direction of establishing the recommended World Health Research Center. WHO had created a new institute, though without the component center for scientific information so strongly advocated by Martin Kaplan. Nor had any steps been taken to establish the proposed World Center for Storage and Retrieval of Scientific Information or for an International Science Foundation, to be modeled on the U.S. National Science Foundation, as recommended by the Venice Pugwash Conference to promote scientific and technological research in countries lacking adequate support of science. Did the several proposals contain inherent defects? Did the scale of support required prove beyond the financial means of the United Nations agencies? Were the proposals sufficiently considered by groups with the power to organize and support the needed agencies or centers? In the absence of any clear answer to these questions, the Working Group proposed that a special Pugwash Conference should be called to study the problem in more depth, including both its scientific and technological aspects as well as the organizational status and relationship to existing international scientific organizations. In addition, the Working Group recommended that special attention be given to ways in which existing U.N. organizations need to be modified in order to function effectively in this area, on a level of excellence like that of the International Center for Theoretical Physics at Trieste.

**Success?**

The past decade thus shows repeated attention given to problems of scientific information by the Pugwash scientists of East and West. Recommendations have been made with increasing urgency and specificity, although lacking technical expertise. The national and international bodies possessing the money and the authority to organize, support, and develop more effective systems for the storage, retrieval, and analysis of information have been slow to respond. Nevertheless, discussions of these matters were begun in UNESCO and ICSU, and in December 1967 a conference held in Paris adopted a plan for a feasibility study of the compatibility of existing and proposed information systems, and funded it. A bright and hopeful ray!

Why is it that in this area, where it should be far easier to achieve real scientific cooperation, even less has been accomplished than in the difficult area of agreements to ban nuclear testing and any further spread of nuclear weapons to additional nations? In large part, I suppose, the difficulty traces back to the fundamental structure of scientific organization in most countries. These activities are in the hands of individual scientists and scientific societies, notoriously individualistic and independent. If it has taken several decades to develop the beginnings of national science information services even within biology, chemistry, or physics, we should not be discouraged that the international efforts are slow to be born. Repeated demands for international cooperation on these problems by scientists of many nations, through the Pugwash Conferences and elsewhere, may eventually produce either a World Center of Scientific Information or a worldwide network of such centers serving different disciplines by means of compatible systems. We cannot afford to give up the effort, for meanwhile we are drowning in floods of paper.

**References and Notes**


1. J. Rotblat, *Pugwash—A History of the Conferences on Science and World Affairs* (Czechoslovak Academy of Sciences, Prague, 1967).
2. B. Glass, *Bull. Atomic Scientists* **18**, 6–12 (Oct. 1962); M. M. Dubinin, *ibid.*, pp. 13–15.
3. M. M. Dubinin, in *Proceedings of the Thirteenth Pugwash Conference on Science and World Affairs, Karlovy Vary, Czechoslovakia, September 13–19, 1964* (privately circulated), pp. 116–119.
4. B. Glass, in ref. *3*, pp. 140–142.
5. Report of Working Group 5, in ref. *3*, pp. 50–51.
6. Unpublished draft of report of Working Group 4, Seventeenth Pugwash Conference on Science and World Affairs, Ronneby, Sweden, 3–9 September 1967.


**NEWS AND COMMENT**

# International Biological Program: U.S. Effort Stands on Shaky Ground

American participation in the 50-nation International Biological Program (IBP), the largest and most ambitious ecological research effort ever undertaken, stands "on shaky ground—organizationally and financially," according to a report* made public this week by the House subcommittee on science, research, and development. The subcommittee, chaired by Emilio Q. Daddario (D–Conn), cites "four major difficulties . . . standing in the way of a meaningful and successful IBP endeavor on the part of the United States." These are "loose" administration, an "inadequate and unrealistic mode of funding," a shortage of trained ecologists, and lack of concern for the program on the part of the public, the Congress, and the Executive branch. Though the report is constructive in tone and singles out no particular villians for blame, it amounts to a low-key indictment of the rather disjointed and slow-as-molasses American planning for the IBP.

Although the scheduled starting date for the IBP was last July, at this writing not a single major U.S. project has been assured of funding, and American IBP officials have decided to reduce the scope of their program to about one fourth or less of its once-projected size. "Our program is just oozing along like a glacier," one top planner told *Science* last week.

In an effort to get the program "off the ground," the Daddario subcommittee recommends that the federal government provide financing of $3 million to $5 million from its contingency funds for fiscal year 1969 and give a "firm commitment . . . to support the IBP to the maximum feasible extent" for the full 5-year term of the IBP, or even longer if necessary. But with the austerity mood that grips Washington today in the wake of the gold crisis and President Johnson's offer to cut $9 billion from the fiscal 1969 budget, the prospects for substantial IBP funding are still somewhat chancy. As W. Frank Blair, a University of Texas ecologist who is chairman of the U.S. National Committee for the IBP, told his colleagues at a recent meeting: "In all of history we probably couldn't have picked a poorer time to launch this program."

The National Committee estimated at one point that the 5-year U.S. program would require $199.3 million in "new money," of which $11.5 million would be needed the first year. But the Daddario committee reports that "an attempt is underway to reduce the size and cost of the IBP by consolidating the major projects." The subcommittee estimates that the "new money" needed may now fall into the $30- to $50-million range. Significantly, the committee recommends that as much as a third of this money should come from state, local, and private sources rather than from the federal government. The National Committee has thus far concentrated almost all of its efforts on obtaining federal support.

The IBP got its start, according to the generally accepted version of the story, in early 1959 in discussions between the British biochemist Sir Ru-

*Available free from the House Science and Astronautics Committee, 2321 Rayburn Building, Washington, D.C. 20024. The report contains a brief analysis and a series of recommendations prepared by the research subcommittee and its staff, headed by Philip B. Yeager, and a long background report prepared by Freeman Quimby and Marcia Carlin of the Science Policy Research Division of the Library of Congress.