News of Science

War Prevention and International Cooperation: Statement of Third Pugwash Conference of Nuclear Scientists, Austria, 14–21 September

Necessity to End Wars

We meet in Kitzbuhel and in Vienna at a time when it has become evident that the development of nuclear weapons makes it possible for man to destroy civilization and, indeed, himself; the means of destruction are being made ever more efficient. The scientists attending our meetings have long been concerned with this development, and they are unanimous in the opinion that a full-scale nuclear war would be a world-wide catastrophe of unprecedented magnitude.

In our opinion defense against nuclear attack is very difficult. Unfounded faith in defensive measures may even contribute to an outbreak of war.

Although the nations may agree to eliminate nuclear weapons and other weapons of mass destruction from the arsenals of the world, the knowledge of how to produce such weapons can never be destroyed. They remain for all time a potential threat for mankind. In any future major war, each belligerent state will feel not only free but compelled to undertake immediate production of nuclear weapons; for no state, when at war, can be sure that such steps are not being taken by the enemy. We believe that, in such a situation, a major industrial power would require less than one year to begin accumulating atomic weapons. From then on, the only restraint against their employment in war would be agreements not to use them, which were concluded in times of peace. The decisive power of nuclear weapons, however, would make the temptation to use them almost irresistible, particularly to leaders who are facing defeat. It appears therefore that atomic weapons are likely to be employed in any future major war with all their terrible consequences.

It is sometimes suggested that localized wars, with limited objective, might still be fought without catastrophic consequences. History shows, however, that the risk of local conflicts growing into major wars is too great to be acceptable in the age of weapons of mass destruction. Mankind must therefore set itself the task of eliminating all wars, including local wars.

Requirements for Ending the Arms Race

The armaments race is the result of distrust between states; it also contributes to this distrust. Any step that mitigates the arms race, and leads to even small reductions in armaments and armed forces, on an equitable basis and subject to necessary control, is therefore desirable. We welcome all steps in this direction and, in particular, the recent agreement in Geneva between representatives of East and West about the feasibility of detecting test explosions. As scientists, we take particular pleasure in the fact that this unanimous agreement, the first after a long series of unsuccessful international disarmament negotiations, was made possible by mutual understanding and a common objective approach by scientists from different countries. We note with satisfaction that the governments of the U.S.A., U.S.S.R., and U.K. have approved the statements and the conclusion contained in the report of the technical experts. This is a significant success; we most earnestly hope that this approval will soon be followed by an international agreement leading to the cessation of all nuclear weapon tests and an effective system of control. This would be a first step toward the relaxation of international tension and the end of the arms race.

It is generally agreed that any agreement on disarmament and in particular nuclear disarmament, requires measures of control to protect every party from possible evasion. Through their technical competence, scientists are well aware that effective control will in some cases be relatively easy, while it is very difficult in others. For example, the conference of experts in Geneva has agreed that the cessation of bomb tests could be monitored by a suitable network of detecting stations. On the other hand, it will be a technical problem of great difficulty to account fully for existing stocks of nuclear weapons and other means of mass destruction. An agreement to cease production of nuclear weapons presents a problem of intermediate technical difficulty between these two extreme examples.

We recognize that the accumulation of large stocks of nuclear weapons has made a completely reliable system of controls for far-reaching nuclear disarmament extremely difficult, perhaps impossible. For this disarmament to become possible, nations may have to depend, in addition to a practical degree of technical verification, on a combination of political agreements, of successful international security arrangements, and of experience of successful cooperation in various areas. Together, these can create the climate of mutual trust, which does not now exist, and an assurance that nations recognize the mutual political advantages of avoiding suspicion.

Recognizing the difficulties of the technological situation, scientists feel an obligation to impress on their peoples and on their governments the need for policies which will encourage international trust and reduce mutual apprehension. Mutual apprehensions cannot be reduced by assertions of good will; their reduction will require political adjustment and the establishment of active cooperation.

What War Would Mean

Our conclusions about the possible consequences of war have been supported by reports and papers submitted to our Conference. These documents indicate that if, in a future war, a substantial proportion of the nuclear weapons already manufactured were delivered against urban targets, most centres of civilization in the belligerent countries would be totally destroyed, and most of their populations killed. This would be true whether the bombs used derived most of their power from fusion reactions (so-called "clean" bombs) or principally from fission reactions (so-called "dirty" bombs). In addition to destroying major centres of population and industry, such bombs would also wreck the economy of the country attacked, through the destruction of vital means of distribution and communication.

Major states have already accumulated large stocks of "dirty" nuclear weapons; it appears that they are continuing to do so. From a strictly military point of view, dirty bombs have advantages in some situations; this makes likely their use in a major war.

The local fall-out resulting from extensive use of "dirty" bombs woud cause the death of a large part of the population in the country attacked. Following their explosion in large numbers (each explosion equivalent to that of millions of tons of ordinary chemical explosive), radioactive fall-out would be distributed, not only over the territory to which they were delivered but, in varying intensity, over the rest of the earth's surface. Many millions of deaths would thus be produced, not only in belligerent but also in

non-belligerent countries, by the acute effects of radiation.

There would be, further, substantial long-term radiation damage, to human and other organisms everywhere, from somatic effects such as leukemia, bone cancer, and shortening of the life span; and from genetic damage affecting the hereditary traits transmitted to the progeny.

Knowledge of human genetics is not yet sufficient to allow precise predictions of consequences likely to arise from the considerable increase in the rate of mutation which would ensue from unrestricted nuclear war. However, geneticists believe that they may well be serious for the future of a surviving world population.

It is sometimes suggested that in a future war, the use of nuclear weapons might be restricted to objectives such as military bases, troop concentrations, airfields, and other communication centres; and that attacks on large centres of population could thus be avoided.

Even tactical weapons now have a large radius of action; cities and towns are commonly closely associated with centres of supply and transportation. We, therefore, believe that even a "restricted" war would lead, despite attempted limitation of targets, to widespread devastation of the territory in which it took place, and to the destruction of much of its population. Further, an agreement not to use cities for military purposes, entered into in order to justify their immunity from attack, is unlikely to be maintained to the end of a war, particularly by the losing side. The latter would also be strongly tempted to use nuclear bombs against the population centres of the enemy, in the hope of breaking his will to continue the war.

Hazards of Bomb Tests

At our first conference it had been agreed that while the biological hazards of bomb tests may be small compared with similar hazards to which mankind is exposed from other sources, hazards from tests exist and should receive close and continued study. Since then, an extensive investigation by the United Nations Scientific Committee on the Effects of Atomic Radiation has been carried out and its authoritative conclusions published. In this case, too, scientists from many different countries have been able to arrive at a unanimous agreement. Their conclusions confirm that the bomb tests produce a definite hazard and that they will claim a significant number of victims in present and following generations. Though the magnitude of the genetic damage appears to be relatively small compared with that produced by natural causes, the incidence of leukemia and bone cancer due to the radioactivity from test explosions may, in the estimate of the U.N. committee, add significantly to the natural incidence of these diseases. This conclusion depends on the assumption (not shared by all authorities in the field) that these effects can be produced even by the smallest amount of radiation. This uncertainty calls for extensive study and, in the meantime, for a prudent acceptance of the most pessimistic assumption. It lends emphasis to the generally agreed conclusion that all unnecessary exposure of mankind to radiation is undesirable and should be avoided.

It goes without saying that the biological damage from a war, in which many nuclear bombs would be used, would be incomparably larger than that from tests; the main immediate problem before mankind is thus the establishment of conditions that would eliminate war.

Science and International Cooperation

We believe that, as scientists, we have an important contribution to make toward establishing trust and cooperation among nations. Science is, by long tradition, an international undertaking. Scientists with different national allegiances easily find a common basis of understanding: they use the same concepts and the same methods; they work toward common intellectual goals, despite differences in philosophical, economic, or political views. The rapidly growing importance of science in the affairs of mankind increases the importance of the community of understanding.

The ability of scientists all over the world to understand one another, and to work together, is an excellent instrument for bridging the gap between nations and for uniting them around common aims. We believe that working together in every field where international cooperation proves possible makes an important contribution toward establishing an appreciation of the community of nations. It can contribute to the development of the climate of mutual trust, which is necessary for the resolution of political conflicts between nations, and which is an essential background to effective disarmament. We hope scientists everywhere will recognize their responsibility, to mankind and to their own nations, to contribute thought, time, and energy to the furthering of international cooperation.

Several international scientific undertakings have already had considerable success. We mention only the century-old, world-wide cooperation in weather science, the two International Polar Years which preceded (by seventy-five and twenty-five years respectively), the present International Geophysical Year, and the Atoms-for-Peace Conferences. We earnestly hope that efforts will be made to initiate similar collaboration in other fields of study. Certainly they will have the enthusiastic support of scientists all over the world.

We call for an increase in the unrestricted flow of scientific information among nations, and for a wide exchange of scientists. We believe that nations which build their national security on secrecy of scientific developments sacrifice the interests of peace, and of the progress of science, for temporary advantages. It is our belief that science can best serve mankind if it is free from interference by any dogma imposed from the outside, and if it exercises its right to question all postulates, including its own.

Technology in the Service of Peace

In our time, pure and applied science have become increasingly interdependent. The achievements of fundamental, experimental and theoretical science are more and more rapidly transformed into new technological developments. This accelerated trend is manifest, alike in the creation of weapons of increased destructiveness, and in the development of means for the increased wealth and well-being of mankind. We believe that the tradition of mutual understanding and of international cooperation, which have long existed in fundamental science, can and should be extended to many fields of technology. The International Atomic Energy Agency, for example, aims not merely at cooperation for establishing facts about atomic energy, but also at helping the nations of the world to develop a new source of energy as a basis for the improvement of their material welfare. We believe that international cooperation in this and other fields, such as economic development and the promotion of health, should be greatly strengthened.

The extremely low level of living in the industrially underdeveloped countries of the world is and will remain a source of international tension. We see an urgent need to forward studies and programs for the effective industrialization of these countries. This would not only improve the level of living of the majority of the population of the world; it would also help reduce the sources of conflict between the highly industrialized powers. Such studies would offer fruitful scope for cooperative efforts between scientists of all nations.

The great increase in the ease and speed of communications, and our increasing understanding of how the forces of nature influence the living conditions of nations in different parts of the world, show us, in a way not previously possible, the extent to which the prosperity of individual nations is connected with, and dependent upon, that of mankind as a whole; and how rapidly it could be

increased by common international effort. We believe that through such common effort, the coexistence between nations of different social and economic structure can become not merely peaceful and competitive, but to an increasing degree cooperative, and therefore more stable.

As scientists, we are deeply aware of the great change in the condition of mankind which has been brought about by the modern development and application of science. Given peace, mankind stands at the beginning of a great scientific age. Science can provide mankind with an ever-increasing understanding of the forces of nature, and the means of harnessing them. This will bring about a great increase in the well-being, health, and prosperity of all men.

The Responsibility of Scientists

We believe it to be a responsibility of scientists in all countries to contribute to the education of the peoples by spreading among them a wide understanding of the dangers and potentialities offered by the unprecedented growth of science. We appeal to our colleagues everywhere to contribute to this effort, both through enlightenment of adult populations, and through education of the coming generations. In particular, education should stress improvement of all forms of human relations and should eliminate any glorification of war and violence.

Scientists are, because of their special knowledge, well equipped for early awareness of the danger and the promise arising from scientific discoveries. Hence, they have a special competence and a special responsibility in relation to the most pressing problems of our times.

In the present conditions of distrust between nations, and of the race for military supremacy which arises from it, all branches of science—physics, chemistry, biology, psychology—have become increasingly involved in military developments. In the eyes of the people of many countries, science has become associated with the development of weapons. Scientists are either admired for their contribution to national security, or damned for having brought mankind into jeopardy by their invention of weapons of mass destruction. The increasing material support which science now enjoys in many countries is mainly due to its importance, direct or indirect, to the military strength of the nation and to its degree of success in the arms race. This diverts science from its true purpose, which is to increase human knowledge, and to promote man's mastery over the forces of nature for the benefit of all.

We deplore the conditions which lead to this situation, and appeal to all peoples and their governments to establish conditions of lasting and stable peace.

Signers

This statement was unanimously adopted by the following scientists:

Australia. M. L. E. Oliphant and Hans Thirring.

Canada. Brock Chisholm and Sir Robert Watson–Watt.

Czechoslovakia. Viktor Knapp and J. Kozesnik.

Denmark. Mogens Pihl.

France. Father Daniel DuBarle, Bernard Gregory, J. Gueron, and Antoine Lacassagne.

German Democratic Republic. Gunther Rienacker.

Federal Republic of Germany. Max Born, G. Burkhardt, Helmut Honl, Werner Kliefoth, and Hanfried Lenz.

Great Britain. Lord Boyd-Orr, Dame Kathleen Lonsdale, C. F. Powell, M. H. L. Pryce, J. Rotblat, and George Thomson.

Hungary. Lajos Janossy.

India. K. S. Krishnan and P. C. Mahalanobis.

Italy. E. Amaldi and E. Boeri.

Japan. Iwao Ogawa, S. Tomonaga, Yasuo Miyake, Shoichi Sakata.

Netherlands. B. R. A. Nijboer.

Norway. Gunnar Randers.

Poland. Leopold Infeld.

United States. Harrison Brown, David Cavers, William Davidon, Bernard Feld, Bentley Glass, Morton Grodzins, David Hill, H. J. Muller, Jay Orear, Harry Palevsky, Linus Pauling, Vance L. Sailor, Frederick Seitz, Walter Selove, Eugene Rabinowitch, Alvin Weinberg, Victor Weisskopf, and Eugene Wigner.

U.S.S.R. N. N. Bogolubov, N. A. Dobrotin, E. K. Fedorov, E. A. Korotin, A. M. Kuzin, V. P. Pavlichenko, D. V. Skobeltzyn, A. V. Topchiev, V. S. Vavilov, and A. P. Vinogradov.

Yugoslavia. Paul Savic.

Division Changes at National Institutes of Health

The U.S. Public Health Service has announced the creation of the Division of General Medical Sciences and the reorganization of the Division of Research Grants at the National Institutes of Health. The new division will have three main functions: (i) administration of research project grants in the basic sciences and other fields, (ii) support of training in the medical sciences through fellowships to individuals and research training grants to universities and medical colleges, and (iii) administration of the Center for Aging Research. The first two functions have been transferred from the Division of Research Grants; the third from the National Heart Institute.

The Division of Research Grants becomes responsible for the study and evaluation of all research grant and fellowships programs at the National Institutes of Health. It will continue to provide for all institutes and divisions (i) a mechanism for technical review of applications for grants and fellowship awards through 30 consultant panels called study sections, and (ii) business operations for processing and paying of grant and award funds.

G. Halsey Hunt, formerly chief of the Public Health Service's Hospital Division and more recently director of the Center for Aging Research, has been named chief of the Division of General Medical Sciences. Ernest M. Allen will continue to serve as chief of the Division of Research Grants.

Education in the United States

Educational levels in the United States have been rising steadily since World War II, according to a report from the Metropolitan Life Insurance Company. In 1957 more than two-fifths of the population at ages 25 and over had at least a secondary-school education, compared with only one-fourth in 1940. During the same period the proportion of adults with limited schooling declined substantially, those with less than 5 years of formal education dropping from about 14 percent to 9 percent.

As a result of the long-term trend toward increased schooling, the proportion of persons who have gone through high school or beyond is now markedly greater at the young adult ages than at the older ages. For example, two-thirds of the white women now aged 20 to 24 have had that much education. By comparison, the proportion is two-fifths for women at ages 45 to 54 years and only a little more than one-fifth for those past 65.

With the continuing rise in the educational level, by 1975 more than one-half of the adult population will have had at least a high-school education, and almost one-tenth will have received a college degree. Among the white male population, about one-seventh will have completed college. It is predicted that the population of college graduates in the country in 1975 will be at least two-thirds greater than the present total of 8 million.

National Institute for Atmospheric Research

Fourteen universities are represented on a University Committee for Atmospheric Research that is establishing a National Institute for Atmospheric Research with a federally supported, multimillion-dollar, 5-year budget. Twelve of the institutions already have pledged participation in a nonprofit corporation to