1979, and experiment with retrieving data from the computer files. From this meeting, and the planning efforts of the principal investigators and the secretary to the Committee, the following priorities were established for the year 1978-79:

1) All data concerning sources for the history of biochemistry and molecular biology which have been gathered by the Survey will be incorporated into the computer file;
2) Archivists will be served by providing repositories with indexes to that portion of their collections related to biochemistry and molecular biology and with cross-references to collections of materials relating to all persons represented in their collections;
3) Historians will be served by the publication, in late 1979, of a guide to sources for the history of biochemistry and molecular biology.

The volume will contain, in brief form, much of the basic information concerning individual scientists and their institutions that has been collected by the Survey since its inception; moreover, it will be designed to lead the reader into the more complex patterns of interrelations that can be evoked by use of the computer system.

The Committee again wishes to express its appreciation to the individuals and foundations that have enabled it to become a valued research tool for historians and sociologists of science.

Respectfully submitted,
John T. Edsall, *Chairman*
David Bearman, *Secretary to the Survey of Sources*

Report of the Conference on Policies for Chemical Weapons and Chemical Arms Control

Although at the present time many nations are actively reviewing their policies with respect to chemical weapons, a number of scholars and others have expressed concern that this effort might be impeded in view of the absence of a generally available analytical discussion of the principal policy options for the U.S. and its allies. Therefore, it was decided to organize a conference to provide an opportunity for this systematic analysis of the critical issues and to develop a document which could serve as the framework for the official deliberations. This meeting took place at the American Academy in January, 1977, co-sponsored by the Academy and the Carnegie Endowment for International Peace. Those invited to participate included persons with broad experience in defense and arms control, as well as those with special knowledge of chemical weapons, in order to bring a wide range of expertise to the assessment of the military utility of chemical agents. The discussion focused on chemical weapons in the context of the defense of Europe since it was felt that the uncertainties surrounding the utility of chemical agents could be analyzed most usefully in that framework.

Three papers were commissioned for this meeting: "Defense Planning for Chemical Weapons," prepared by several members of the Office of the Deputy Chief of Staff for

Operations and Plans, Department of the Army, and presented by Brigadier General Lynwood B. Lennon; "Should NATO Have Chemical Weapons? A Framework for Considering Policy Alternatives" by Julian Perry Robinson of the Science Policy Research Unit, University of Sussex; and "Preventing Chemical Warfare" by Robert Mikulak of the U.S. Arms Control and Disarmament Agency.

The use in war of poison gas and other chemical weapons is prohibited by the Geneva Protocol of 1925, to which all the major nations of the world, including the members of the North Atlantic Treaty Organization and the Warsaw Pact, are parties. The United States, the Soviet Union, and several other parties have, however, formally reserved the right to use chemical weapons in retaliation if the protocol is violated by an adversary. At present, the United States maintains a considerable stockpile of poison gas weapons, the continued existence of which is premised on its potential retaliatory role and on intelligence estimates that the Soviets likewise have substantial stocks. But the U.S. stockpile, produced mainly in the 1950's and 1960's, is in some respects not well suited to current military conditions. Its utility for retaliation is further limited by reluctance among NATO governments, for both political and military reasons, to integrate a chemical retaliatory capability into alliance force structures and defense planning.

An alternative to the policy of retaliation in kind is to renounce chemical weapons, subject to the negotiation of an acceptable arms control agreement committing the Soviets and others to do the same. The United States, first unilaterally in 1969 and then under the Biological Weapons Convention of 1972, has already renounced biological warfare and the development, production, and possession of biological weapons. Article IX of the convention pledges its parties to conduct negotiations for the effective prohibition of chemical weapons, including the destruction of stocks and the cessation of development and production. There is considerable international sentiment in favor of such a prohibition and the Soviet Union, Japan, and the United Kingdom have each put forward draft chemical disarmament treaties, differing rather widely, however, with respect to verification provisions. At the Moscow summit meeting of June, 1974, President Nixon and General Secretary Brezhnev declared their agreement to try to formulate a joint initiative on the prohibition of chemical weapons for presentation at the international disarmament talks in Geneva. This agreement was reaffirmed by President Ford and Brezhnev at Vladivostok the following November. In August, 1976, a series of U.S.-USSR meetings was initiated in Geneva, which by late 1977 had reached the stage of drafting a joint document.

The current military and diplomatic scene places U.S. policy for chemical weapons at a crossroads. Before much longer, a decision may be made to retire chemical weapons from the U.S. arsenal under a new arms control treaty, or, if a satisfactory treaty seems currently unachievable, the decision could be instead to seek procurement of a new generation of chemical weapons, while trying to persuade NATO to integrate them into defense planning.

The paper on "Defense Planning for Chemical Warfare," while supporting the continuation of efforts to achieve chemical disarmament, sets forth the case for maintaining a U.S. retaliatory chemical capability until and unless a meaningful chemical disarmament treaty can be negotiated. First, it is argued that the threat of retaliation in kind is an important component of deterrence against Soviet initation of

chemical warfare in case of war in Europe. Second, if the Soviets nevertheless do use chemicals in an otherwise conventional war, it is contended that our retaliation in kind could provide a means for offsetting their initial advantage, short of crossing the nuclear threshold. The conference participants discussed the various chemical weapons and the defenses against them to put these arguments into perspective.

The principal chemicals in question are the nerve agents first produced, but not used, by Germany during World War II. Today, only the United States and the Soviet Union are thought to have major stockpiles of these or other chemical weapons. Related to the organophosphorus insecticides, but far more toxic for man, nerve agents kill by interfering with nerve impulses essential for respiration and other vital functions and are rapidly lethal when inhaled or when deposited in liquid form on the skin. Existing nerve agent weapons include artillery projectiles, rockets, mines, bombs, and warheads for short-range missiles, all designed for the support of tactical battlefield operations.

Despite the potential of nerve agents for inflicting massive casualties on unprotected personnel, quite effective defenses against them and other chemical warfare agents are available in the form of gas masks, protective clothing, and other equipment. After years of relatively little emphasis on chemical protective measures, NATO troops are being provided with newly developed lightweight protective suits and are being given more intensive training in chemical defense. Judging from observations of field exercises and from other indicators, Soviet troops in Europe are very well trained in chemical defense, although their suits and masks are more cumbersome than ours.

Of course, if protective measures could sufficiently reduce the military effects of chemical attack, there would be little incentive to expend resources on chemical weapons at all. But wearing suits and masks and operating in a toxic chemical environment complicates military operations and increases the psychological stress of warfare. Therefore, even if a chemical attack could be sustained with few direct casualties, its effect in reducing efficiency and causing delays in critical combat and support activities could be significant. Just how significant is a matter for debate and continued study, as is apparent in the range of views expressed at the meeting.

Whether or not chemical weapons are cost-effective from a purely tactical point of view, broader strategic and political considerations appear to preclude matching, even approximately, the presumed Soviet capability to wage chemical war along an extended front. The Federal Republic of Germany, in particular, while emphasizing chemical protective measures for its troops, has emphatically stated its intention not to train its forces in the use of chemical weapons now or in the future. The reasons for this policy reflect a basic problem of NATO defense doctrine. With NATO and Warsaw Pact troops in suits and masks, any large-scale chemical warfare in central Europe could inflict far higher casualties on civilians living near the combat zone than on the combatants. While this consideration might not greatly limit the selection of targets by the Soviets, it certainly would do so for NATO forces fighting on home ground. Moreover, while subjecting European civilians to the equivalent of strategic attack, chemicals, unlike theater nuclear weapons, would pose no direct escalatory threat to the Soviet Union itself and would therefore have little deterrent effect in limiting or terminating hostilities in Europe. Indeed, there is concern that any major reliance on chemicals would undermine the credibility of the nuclear deterrent itself. These

concerns could be accommodated to some extent by a NATO policy of strictly limiting chemical retaliation to certain highly selected targets, avoiding general battlefield use. But it is not clear whether NATO can be genuinely persuaded to implement such a policy, nor whether NATO chemicals would be very effective under such rigid constraints.

These considerations suggest that there would be considerable advantage to NATO in trying to remove or minimize the Soviet chemical threat through arms control and chemical protective measures, rather than to continue a policy of chemical deterrence and retaliation in kind. Also, as stressed particularly in the historical analysis presented by Julian Perry Robinson, it can be argued that arms control is the only approach that can halt the possible future expansion of the chemical threat posed both by the Soviet Union and by other parties which may otherwise acquire chemical weapons.

From the perspective of the Soviets, with their long history of fighting wars deep inside their own territory, there may also be a genuine interest in chemical disarmament. If so, it may be possible to arrive at an agreement with sufficient safeguards to persuade the West that the benefits substantially outweigh the risks. While pointing out the difficulties, especially in connection with the issue of verification, Robert Mikulak, in his paper, delineated some of the basic considerations and components that could be embodied in such a treaty.

A list of specific arms control provisions that could serve as a framework for negotiation of a treaty by the United States was discussed on the second day of the conference. Such a treaty would prohibit the production and possession of chemical weapons and provide, among other things, for mutually observed destruction of existing stocks and the dismantling or conversion of chemical weapons-production facilities. It would also create a permanent commission to foster communication and cooperation in problems of toxic waste disposal during the several years required to destroy chemical weapons stocks and, thereafter, to deal with any residual problems as well as other problems of mutual interest in toxic waste disposal and related fields.

If this or some other approach proved to be successful and led to an international prohibition against chemical weapons of war to accompany the existing prohibition against biological weapons, the way would be open to establish the principle that our increasingly profound scientific understanding of basic life processes be directed solely to beneficial purposes, and that research in this area be conducted as much as possible under the conditions of openness and public scrutiny that are probably necessary to insure such beneficial use.

The proceedings of this conference, including the papers and transcripts of the discussion, were published this spring by the Carnegie Endowment. Along with the financial and administrative assistance received from the Academy and the Endowment, the project was also supported by grants from the Johnson Foundation, the Ford Foundation, and Harvard University's Program for Science and International Affairs. The project organizers are most grateful for this assistance.

Respectfully submitted,
Matthew Meselson, *Chairman*

Participants in the Conference on Policies for Chemical Weapons and Chemical Arms Control

Richard R. Baxter
Harvard University

George Berdes
Committee on International Relations
U.S. House of Representatives

Harvey Brooks
Harvard University

Steven Canby
Washington, D.C.

Albert Carnesale
Harvard University

John D. Christie
Federal Energy Administration

Thomas A. Dine
Committee on the Budget
U.S. Senate

Paul Doty
Harvard University

Hubert Feigl
Research Institute for International Affairs
(Federal Republic of Germany)

Bernard T. Feld
Massachusetts Institute of Technology

James S. Finan
Department of National Defence (Canada)

Michael Guhin
Nuclear Regulatory Commission

Thomas A. Halsted
Carnegie Endowment for International Peace

Arthur C. Herrington
Cohasset, Massachusetts

Donald Hornig
Harvard University

L. Craig Johnstone
U.S. Foreign Service

Martin M. Kaplan
Pugwash Conferences on Science and
World Affairs

George B. Kistiakowsky
Harvard University

Lynwood B. Lennon
U.S. Army

James F. Leonard
United Nations Association of the U.S.

Christopher Makins
Lehrman Institute

Matthew Meselson
Harvard University

Robert Mikulak
U.S. Arms Control and Disarmament Agency

Julian Perry Robinson
University of Sussex

Enid B. Schoettle
Ford Foundation

Herbert Scoville, Jr.
Arms Control Association

William Stokes
U.S. Army

Report of the American Academy of Arts and Sciences and National Academy of Sciences Joint Committee on Pugwash Conferences and Other International Programs

The U.S. Pugwash Committee is a participant in the organization known as the Pugwash Conferences on Science and World Affairs, a confederation of national groups of scientists from over thirty countries, concerned primarily with problems of disarmament and, in recent years to a somewhat lesser degree, with scientific and security issues associated with development. The latest Pugwash Conference, held in August 1977 in Munich, marked the twentieth anniversary of the Pugwash movement.