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Mr. John Greenewald, Jr.
[REDACTED]
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Re: FEMA 09-807

Dear Mr. Greenewald:

This is the final response to your July 27, 2009, Freedom of Information Act (FOIA) request transferred from the Defense Technical Information Center (DTIC) to the Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) for a copy of the following document:

Accession Number: AD0002942

Title: Civil Defense Aspects of Biological, Chemical, and Radiological Warfare against Crops, Animals, and Man – Part IV – Project East River

Date: 23 Jun 1952

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Report numbers: XA-DA

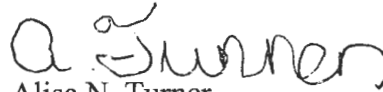
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If you need to contact us about this request, please refer to **FEMA 09-807**. You may contact this office at (202) 646-3323.

Sincerely,

A handwritten signature in black ink that reads "Alisa N. Turner". The signature is written in a cursive style with a large initial "A".

Alisa N. Turner
Chief, Disclosure Branch
Records Management Office
Management Directorate

Enclosure(s): 72 pages

cc: Mr. Michael Hamilton
Acting FOIA Program Manager
Defense Technical Information Center
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Ft. Belvoir, VA 22060-6218

**Civil Defense Aspects of Biological, Chemical, and
Radiological Warfare Against Crops, Animals, and Man -
Part IV - Project East River**

ASSOCIATED UNIVERSITIES INC NEW YORK

23 JUN 1952

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OF
BIOLOGICAL, CHEMICAL, AND RADIOLOGICAL WARFARE
AGAINST
CROPS, ANIMALS, AND MAN**

Part IV
of the
Report of the
PROJECT EAST RIVER
June, 23, 1952

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BIOLOGICAL, CHEMICAL, AND RADIOLOGICAL WARFARE
AGAINST
CROPS, ANIMALS, AND MAN**

Part IV
of the
Report of the
PROJECT EAST RIVER
June 23, 1952

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**CIVIL DEFENSE ASPECTS
OF
BIOLOGICAL, CHEMICAL, AND RADIOLOGICAL WARFARE
AGAINST
CROPS, ANIMALS, AND MAN**

Part IV
of the
Report of the
PROJECT EAST RIVER

June, 23, 1952

Members of the CEBAR Panel

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Dr. M. R. Clarkson, Asst. to the Administrator, Agricultural Research Administration, in charge of Defense
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TC: The Secretary of Defense
The Chairman, National Security Resources Board
The Administrator, Federal Civil Defense Administration

PROJECT EAST RIVER was initiated under the joint sponsorship of the Department of Defense, the National Security Resources Board, and the Federal Civil Defense Administration with the assignment to "evaluate and recommend the optimum combination of non-military measures which will assist (1) the FCDA to discharge its responsibilities for preparing to minimize the effects of attack by atomic, biological, chemical or other weapons on the population and industry of the United States, (2) the NSRB in discharging its responsibilities to advise the President concerning the strategic location of industries, services, governments, and economic activities, the continuous operation of which is essential to the Nation's security, and (3) the Department of Defense in collaborating with FCDA and NSRB to discharge their responsibilities".

Our total report consists of ten parts, of which this is Part IV: *The Civil Defense Aspects of Biological, Chemical and Radiological Warfare Against Man, Animals and Crops*. It is our considered opinion that a potential enemy has, or soon will have, the capability for major attacks against this country with chemical, biological and radiological weapons; that the resulting casualties could be very extensive and possibly equal to those caused by atomic bombs; that proper civil defense preparations with relatively small expenditures could reduce the number of anticipated casualties by approximately 50 per cent; and that the priority measures and program necessary to accomplish this reduction in casualties are technically and economically feasible at the present time.

Unfortunately, the secrecy with which it has been felt necessary to surround the whole subject of biological, chemical and radiological warfare has resulted in its being too little known or understood. PROJECT EAST RIVER strongly recommends that a balanced program of public information, free from hysteria and scare-techniques, be undertaken at once.

Attention should be focused on the serious damage to man, animals and plants that could result from both overt and covert attack with BW, CW or RW agents as well as on the limitations of these agents. It should be pointed out that practical defenses and effective countermeasures are possible, and that with full understanding and cooperation on the part of the public, disruption of civilian activities and high casualty rates could be avoided.

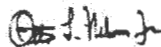
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We urge, also, that the technical information in this report, including especially that concerning local preparation, the equipment and supplies that will be needed, and all other pertinent details, be made widely available to state and local civil defense personnel.

It is hoped that this Report will help bring the subject of biological, chemical and radiological warfare into proper perspective with atomic and conventional attack, so that a balanced program for civil defense may be rapidly achieved.

Sincerely,



Otto L. Nelson, Jr.
Director
PROJECT EAST RIVER

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ACKNOWLEDGMENTS

A number of persons have been of material assistance to the CEBAE Panel members in the preparation of this report. The conclusions and recommendations included therein are, however, exclusively those of the Panel.

Grateful acknowledgment is made to the experts who participated in special briefings for the Panel at Camp Detrick, the Army Chemical Center and the Department of Defense.

The following technical experts reviewed the report at various stages of its development and contributed greatly to its content. Their assistance is deeply appreciated. We extend our thanks to: G. M. Dack, M.D., Director, Food Research Institute, University of Chicago; W. A. Hagen, D.V.M., Dean, New York State Veterinary College; Leland J. Haworth, Ph.D., Director, Brookhaven National Laboratory; A. McGehee Harvey, M. D., Professor of Medicine, The Johns Hopkins University; M. A. McCall, Ph.D., Operations Research Office, The Johns Hopkins University; and Richard E. Shope, M.D., of the Merck Institute for Therapeutic Research.

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Finally, the Panel members wish to express to Miss Lee Anna Embrey, of the National Science Foundation, their sincere appreciation for her contributions to the organization and presentation of this report.

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FOREWORD

The purposes of this report are to indicate on a priority basis the measures essential to meeting the threat of chemical, biological, and radiological attack against the United States of America and to recommend the feasible and necessary steps that should be taken in order to render this country less vulnerable to such attack and to minimize the effects should it occur.

The report is limited to a consideration of chemical, biological, and radiological attack against civilian populations, animals, and crops and the countermeasures to be taken, before, during, and after an overt or covert attack. It does not consider the use of these agents against military populations nor against military or civilian machines and equipment. Although some specific CW and BW agents are mentioned briefly, an effort has been made to deal primarily with the broad problems of policy and operational activities in the fields involved, rather than to attempt to consider the individual problems involved in the detection, identification, treatment and control occasioned by the use of each potential agent.

The conclusions and recommendations are based on studies of the nature of agents that most probably would be used, a potential enemy's capabilities for launching an attack, the vulnerabilities of crops and forests, animals and people in the United States, and measures presently being taken to protect this country from attack.¹

DALE C. CAMERON, M. D.
Chairman, Color Panel

¹ See Supplements to this Report for further discussion of enemy capabilities, logistic problems, and human casualty estimates.

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SUMMARY

PLANNING ASSUMPTIONS.

An enemy will use BW, CW and RW agents available to him when it suits his purpose to do so. If he wishes to preserve our material resources to the maximum extent consistent with winning a war, he may choose BW, CW and RW agents as his weapons.

Without attempting to fathom the intentions of a potential enemy, it must be assumed that one or more of the biological, chemical or radiological warfare weapons probably could be used overtly or covertly when the objective is to:

- (1) Attack food supplies of plant or animal origin.
- (2) Disable men or animals or cause us to divert valuable manpower from the war effort.
- (3) Kill or disable man without unduly disrupting physical facilities.
- (4) Carry a significant payload in craft accompanying atomic bomb carriers.

The use of biological, chemical and radiological agents against the United States of America depends on the immediate purpose of the attack, the capability of an enemy to produce and deliver the agents in effective form, and the vulnerability of the targets.

CONCLUSIONS.

General: There is evidence that a potential enemy has or soon will have the capability of mounting and sustaining major attacks with biological or chemical agents against large population centers, food crops, and animals of this country. Radiological warfare is not believed to be a very great threat in the next few years. If it were used at all it would probably be for the purpose of denying access to limited areas rather than for the production of casualties.*

The enormous numbers of casualties that would result from an overt chemical or biological attack can be reduced approximately 90 per cent by implementation of the recommendations made in this report. Sub-

* See Supplement to this Report.

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stantial numbers still would occur, however. The costs of adequate preparation, although considerable, are small when compared with the potential loss that could take place in an unprepared population.

Threat to Man: The use of biological warfare agents by saboteurs could cause casualties and disruption among selected local population groups, but a major knock-out blow probably could not be dealt unless covert attacks were widespread and synchronized. The prevention of covert attack is largely a problem of internal security, and the detection of such attack is a matter of effective intelligence concerning the outbreak of epidemics.

A potential enemy is believed capable of launching and sustaining an attack with chemical agents, but a suitable gas mask such as the one currently being developed by the Army Chemical Corps will afford effective protection against the most probable agents.

Radiological warfare against civilian populations would probably not be a decisive weapon, but could be used by an enemy to cause panic and confusion and to disrupt normal civilian activities.

Threat to Crops and Forests: Biological warfare agents offer a serious potential threat to the crops of this country, because if these are introduced at the proper time and place by either overt or covert means, extensive epiphytotics would probably result. In many instances, the "build-up" of epiphytotics to damaging proportions could be expected from three to five years after the disease had been introduced. Chemical warfare in the form of balloon-delivered incendiaries would be a serious threat to forests and to grain fields at harvest time. The likelihood of radiological warfare against plants seems small.

Threat to Animals: Animals and fowls are seriously vulnerable to attack by biological agents, because they are highly susceptible to a number of such agents, used in either covert or overt attack. It is quite likely that epizootics would result, if appropriate diseases were to be introduced by a determined enemy. In many instances, the "build-up" of epizootics to damaging proportions could be expected within a year of disease introduction.

The majority of agents that might be used are foreign to the United States. Readiness for eradication or control of diseases introduced into this country requires not only collection of information from foreign sources, but also research directed toward the perfection of diagnostic procedures, the development and testing of vaccines, and toward testing the control of foreign diseases under conditions existing in this country.

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Psychological Factors: Biological, chemical and radiological weapons are "unknowns" for most civilians and many military personnel. As such, they tend to engender unreasoning fear and to provoke widespread speculation as to their destructiveness. One reaction is to attribute to these weapons diabolic powers beyond all reasonable expectations. Another and equally unrealistic view is to underestimate their potency. Without actual experience in modern warfare, the determination of what is the realistic view toward these weapons is difficult, but obviously people cannot be expected to react in a rational fashion if they do not possess the available knowledge concerning these agents. If this country should be thrust into a third world war, civilians will certainly be deeply involved. They must be prepared to react to their vicissitudes realistically. To expect them to do so in the absence of knowledge about the weapons that may be used against them is absurd.

Administrative Problems: The Federal Civil Defense Administration and collaborating Federal agencies have made substantial progress in the development of measures to prevent and to minimize the effects of BW, CW, and RW. However, in some instances, the assignment of responsibility for operational and research activities between the Federal Civil Defense Administration and other government agencies remains unclear. Through lack of clear-cut directives, highly trained individuals and agencies who are well qualified and anxious to help solve some of these problems are not being fully used.

RECOMMENDATIONS.

In the following Section are summarized those recommendations that the Panel on Biological, Chemical and Radiological Warfare, considers to be of major and immediate importance. The detailed recommendations, from which these have been excerpted, will be found in the main body of the report together with a discussion of some of the civil defense problems occasioned by the potential use of biological, chemical and radiological agents in modern war.

Warning and Protective Material:

1. That an inexpensive, mass-producible, anti-gas and anti-particulate general purpose, civilian mask for individuals of school age and above be
 - (a) Tested jointly by the Federal Civil Defense Administration and the Army Chemical Corps and, if acceptable, be standardized for production at once;

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- (b) Procured on a phased schedule in an initial quantity of 70,000,000 by the Federal Civil Defense Administration for re-sale at cost to individuals, with priority given to those in critical target areas; and
 - (c) Distributed through state and local civil defense organizations at a time jointly agreed upon by the National Security Council and the Federal Civil Defense Administration.
2. That the Federal Civil Defense Administration stock-pile, in strategically located areas, drugs and other items for the treatment of casualties caused by the chemical and biological agents most likely to be used.
 3. That the Federal Civil Defense Administration and the Department of Defense jointly direct immediate attention to the development of a detection system that could be used to indicate imminent or actual overt attack with CW or BW agents, as well as to determine the safety of removing gas masks. The Federal Civil Defense Administration siren signal system should be modified to provide a distinctive warning signal.³

Research:

4. That the Federal Civil Defense Administration request the Army Chemical Corps in collaboration with appropriate contractors to intensify research on
 - (a) A suitable inexpensive, mass-producible, anti-gas, and anti-particulate mask and shelter devices for use by infants and pre-school children.
 - (b) Suitable, inexpensive, mass-producible anti-gas and anti-particulate diffusion shelter devices for the protection of individuals of all ages in their homes.
 - (c) Suitable devices for giving individual and group artificial respiration to civilian casualties.
5. That the Federal Civil Defense Administration, through the Department of Defense and the Public Health Service, sponsor research directed to
 - (a) Methods of rapid detection and identification of BW agents.

³ See PROJECT EAST RIVER Report, Warning and Communication.

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- (b) *The development of more efficient methods of immunization against and treatment of those diseases most likely to be introduced by an enemy.*
6. *That the Department of Agriculture, in collaboration with appropriate agencies, study the most probable methods of biological and incendiary attack on crops and forests and devise countermeasures.*
 7. *That every effort be made to obtain support to establish a research laboratory for the study of animal diseases foreign to the United States as authorized in P. L. 496, 80th Congress—2nd Session.*
 8. *That the Department of Agriculture expend its programs for breeding crop strains resistant to probable biological warfare agents, for detection and identification of outbreaks of crop diseases, and for inspection at ports of entry into the United States.*
 9. *That research presently under way on domestic diseases of animals be maintained and expanded—especially to obtain information on methods for more rapid and accurate diagnosis, the development of biologics effective in treating exposed animals, the development of vaccines that will produce long-lasting immunity—and that the program for reporting diseases of domestic animals be expanded and strengthened.*

Information and Technical Data:

10. *That civilians be given immediately appropriate information about biological, chemical and radiological agents, according to a planned, phased schedule that takes into account the time of availability of protective devices. Only if these measures are taken, can people be expected to respond in an enlightened manner during an emergency and to avoid undesirable reactions as a result of ignorance of basic facts.*
11. *That the agencies of the Federal Government now gathering domestic and world-wide technical information on the occurrence of outbreaks of diseases of crops, animals and man:*
 - (a) *Intensify their efforts to obtain complete data.*
 - (b) *Analyze these technical data to determine, if possible, any deviation from the natural pattern that might indicate BW activity and the nature of BW agents that might be used against this country.*
 - (c) *Establish a small professional secretariat to coordinate the special investigations of disease outbreaks to integrate the analyses of the several agencies involved.*

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- (d) Communicate the results of these analyses to the Federal Civil Defense Administration for transmission to appropriate state and local civil defense personnel and other interested agencies.
12. That the Federal Civil Defense Administration and governmental agencies to whom operational responsibility is delegated or whose services are utilized by the Federal Civil Defense Administration, continue and intensify their liaison with agencies responsible for internal security to the end that
- (a) The internal security agencies may be aware of the technical problems involved in sabotage with biological, chemical, or radiological weapons, and
- (b) The Federal Civil Defense Administration and other agencies may be aware of the time and location of probable sabotage activities.

Organization:

13. That the Federal Civil Defense Administration
- (a) Delegate to the U. S. Department of Agriculture responsibility for federal operational activities necessary to minimize the effects of outbreaks of diseases and pests of animals and crops initiated by enemy action, and comparable responsibility to the Public Health Service for outbreaks of diseases among man,
- (b) Retain operational responsibility for medical care of human casualties, and
- (c) Retain responsibility for collaboration in planning all these activities and for coordination of the civil defense efforts of these agencies with those of other governmental agencies.⁴

⁴ This does not mean these agencies would assume the responsibilities of state and local organizations, nor the responsibility of the Federal Bureau of Investigation for internal security.

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INTRODUCTION

BIOLOGICAL WARFARE.

Biological warfare (BW) is (1) the deliberate use of living organisms, toxic biological products, and chemical plant growth regulators to produce death or casualties in man, animals or plants; or, (2) defense against such action by an enemy.

The possible use of biological agents as an instrument of warfare has intrigued the imagination of war-planners for centuries. But although disease and epidemics among men have materially affected the course of many wars, recorded instances of deliberate attempts to infect the enemy are few in number. Diseased bodies and filth were hurled into a German castle during the 16th century. Blankets from a small-pox ward were distributed to the Indians during the French and Indian Wars. Documentary evidence¹ has been produced which indicates that the Germans made numerous attempts to use biological warfare against both animals and crops in World War I. The Chinese accused the Japanese of employing plague against them in 1941. These attempts are but isolated instances, however, and the results were inconclusive.

Since there are no objective data available to the United States of America on the use and effectiveness of biological agents in actual modern warfare, estimates of potential performance must rest largely on extrapolations from a rapidly growing body of experimental data, epidemiology of accidental laboratory infections, hypotheses, and an extensive knowledge of man's ceaseless struggle against human, animal, and crop diseases during the ages. On the basis of some early estimates, it was believed that biological warfare was not feasible because of difficulties in production and delivery. Since most of these problems are technical, however, it must be assumed that they have either been solved or that satisfactory solutions are possible. Civil defense today and in the foreseeable future must, therefore, take account of biological agents.

¹ Captain Henry London, *The Enemy Within*, G. P. Putnam's Sons, 1937

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CHEMICAL WARFARE:

Chemical warfare (CW) is (1) the deliberate use of toxic chemicals, incendiaries and smokes to produce death or casualties in mass, destruction of material, or to provide screening operations against enemy weapons or intelligence; or, (2) defense against such action by an enemy.

Fire has long been one of Man's most potent weapons, but modern chemistry has added materially to the ways in which this ancient weapon can be used. World War I demonstrated conclusively that toxic chemicals, also, can be used effectively against man and animals. Recent developments in the field make it imperative that civilian preparations against any future war include provisions for possible attack with toxic chemicals.

RADIOLOGICAL WARFARE:

Biological warfare (BW) is (1) the deliberate use of radioactive materials (other than atomic bombs) to injure or kill man, animals or plants, or to deny or impede access to contaminated objects or areas through threat of casualties; or, (2) defense against such action by an enemy.

The use of radiological weapons has become possible only within the last few years. Although atomic bombs were used at Hiroshima and Nagasaki, radiological weapons as here defined have never been used in actual warfare. Our knowledge of the effects of these weapons is based on extrapolations from the effects of X-rays, radium, other radioactive isotopes, and the radiation effects of atomic-bomb detonations during and subsequent to World War II.

Radiologic materials can be produced as by-products in the manufacture of fissionable materials or directly by the utilization of neutrons. Extensive use of such materials as weapons appears unlikely in the immediate future, but it is a possibility that cannot be disregarded in civil defense planning.

The Targets:

The principal targets of biological, chemical, and radiological warfare are man, animals, and crops. The threat of each of the agents is not necessarily the same for all of the targets. The Panel has considered the targets in terms of the three types of warfare and various combinations of these and has summed up its findings and recommendations under the broad headings of Man, Animals, and Crops.

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I. MAN

1.1 BIOLOGICAL WARFARE AGAINST MAN.

1.1.1 *Types of Agent:* The biological agents believed most likely to be used against man are those producing the following diseases: Anthrax, Botulism, Brucellosis, Plague, Psittacosis, Q fever, Tularemia, and Venezuelan Equine Encephalitis. It will be noted that, with the exception of Botulism, each of these is a natural disease of lower animals.

1.1.2 *Types of Enemy Attack:* Biological agents are susceptible of utilization for either covert or overt attack; in either case, the weapon would be an anti-personnel agent only and would leave material essentially undamaged.

Covert Use of Biological Warfare: It is clearly evident that infectious agents could be disseminated by saboteurs through the media of water, air or food with varying success. Theoretically, large scale application through a synchronized effort could be accomplished, but safeguards stemming from internal security measures and existing health practices should make questionable a strategic success in such an undertaking. Sporadic and localized use of biological agents would be easier of accomplishment but of a much lower order of effectiveness, as long as internal security and the ordinary medical and health services¹ are intact. Key personnel in government and industry would be the most likely target. The covert use of these agents as a weapon of war—or even of "pre-war" periods—could cause numerous casualties and much expenditure of effort to counteract them, but it is unlikely that their use would decisively influence the outcome of a war.

Overt Use of Biological Warfare: There is adequate evidence to indicate that the mass dissemination of biological agents from planes or guided missiles is a possibility. From the standpoint of civil defense, however, the likelihood of effective attack must be critically evaluated in the light of estimates on enemy research and development, logistics, estimates of relative effectiveness, and what the purpose of the enemy may be. If properly used, they could cause enormous numbers of casualties.

¹ Health services will minimize spread and development of secondary cases, but will not alter the number of primary cases caused by aerosol dissemination.

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1.1.3 Estimate of Enemy's Capabilities: ² According to the planning assumptions upon which this report is based, the enemy would use biological warfare if it suited his purpose, were available to him, and offered sufficient promise of accomplishing his aim. His capabilities of accomplishing some disruption by *covert* attack are clearly evident and are discussed more fully in section 1.1.4.

Among the important factors contributing to an estimate of the enemy's capabilities of *overt* attack are the following:

Development of Weapon: Availability of biological materials and basic knowledge concerning the properties of numerous potentially dangerous biological agents are common to all countries. There is no basis for postulating that the enemy has now an agent of unusual or uniquely lethal qualities about which this country has no information.

Problems of quantity production are not difficult except for the safeguarding of operating personnel. Moderately large installations are required.

Preservation of potency under conditions of storage and handling offers substantial technical difficulties, but basic knowledge is readily available and it can be assumed that any existing difficulties would eventually be overcome.

Development of satisfactory munitions offers major technical difficulties, which again it must be assumed can be surmounted.

Effectiveness: Biological agents vary widely in their natural pathogenicity for human beings, and inherent in their use are the vagaries and complexities of the host-parasite interaction. It is generally agreed that the initiation of a self-perpetuating epidemic is unlikely, but the possibility must not be ignored. Residual contamination of the environment is not considered a major hazard although it may present serious difficulties in local areas. There are many observations, however, indicating that a substantial number of casualties can be produced by direct infection under favorable conditions of munitions production and delivery. But in the absence of actual use of biological agents in modern warfare the potentialities must remain a partially unknown quantity.

It seems unlikely that in an initial attack an enemy would expend the valuable element of surprise and a significant number of planes in the risky gamble inherent in using *only* BW agents when other, and more cer-

² See Supplement to this Report.

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tainly effective weapons, are available. Moreover, used alone, disease-producing agents would encounter the Nation's formidable medical resources. If these are mobilized for early diagnosis, treatment, and immunization, they would mitigate to a significant degree the effects of any presently known biological agent.

On the other hand, combined with some other weapon such as the atomic bomb or even gas, biological agents could help to prolong community disruption and increase the loss of life. Finally, the effects of BW as a psychological weapon will be determined in part by our own approach to the problem. Fear, anxiety, hysteria and even panic, building up in successive stages, could result in attrition in human resources, but these psychological factors by themselves probably would fall far short of proving disastrous to our national defense.

1.1.4 Estimate of Defensive Capabilities Against Biological Warfare:

Against Covert Attack: The most likely targets are small and almost unlimited in number. A knock-out blow against all of them is scarcely to be anticipated. Large-scale synchronized sabotage would involve planning, production and operations of such magnitude that it should be detected by internal security activities.

Defensive measures must be of a general and usually unlocalized nature. Many of these are inherent in existing safeguards and precautionary devices, for example:

- (1) General water supplies of large cities are ordinarily well protected by standard chlorination procedures. However, chlorine-resistant organisms must be considered. Storage, sedimentation, and filtration are added safeguards. Bolstering of these purification procedures could be accomplished within the ordinary structure of sanitary practice if suitable technical information were made available to plant operators. Considerable information is available on the use of chemicals other than chlorine to disinfect water and further research is being carried out in this field.
- (2) It seems highly unlikely that food supplies could be effectively used as vehicles for large-scale transmission of disease agents, because of the protection afforded by multiple sources, processing and cooking. Frozen foods that are served uncooked may present special problems. Un-

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less the sabotage operations were well organized on an extensive scale, the effects would be sporadic and essentially inconsequential from a strategic standpoint unless very critical personnel were involved. The targets are too diffuse to justify specific protective measures. Routine immunization for infectious agents is not regarded as practicable.

- (3) Ordinary and improved diagnostic methods, both bacteriological and epidemiological, afford important defenses. The Sectional Research Program in Microbiology of the Public Health Service currently is active in this field.²
- (4) Normal medical services in urban areas provide a cushion against purposely invoked diseases, but capable biological scientists, doctors, and other workers in the health and medical fields are in short supply.

The possibilities of sabotage against certain key personnel in concentrated areas must not be overlooked, however. Persons working in large buildings and industrial plants could be infected through contamination of local air intakes or ventilating systems. Food contamination in these buildings is also a possibility. Protection of these avenues is largely a problem of internal security, and some measures of this kind have already been taken.

Especially important civilian units may require additional special internal security measures directed toward guarding of water and ventilation intakes.

Because of the wide variety of agents available for use in sabotage, specific immunization of civilians against potential BW agents as such well in advance of an initial attack is not regarded as practicable.

In summary, it may be said that covert attack upon man with biological agents constitutes a real threat, but not one of strategic importance unless many key personnel are involved; that existing medical and health facilities already provide substantial defense against this form of attack; and that although research should be directed to several phases of the problem, substantial commitments in terms of personnel or funds for defense against covert attack, in addition to those contemplated in the 1953 budget request of the Federal Civil Defense Administration, are not indicated except perhaps in the field of internal security.³

² See PROJECT EAST RIVER Report, Health and Welfare.

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*Against Overt Attack:*⁴ The margin of safety with regard to overt attack with biological agents stems more from the assumed present limitations of enemy weapon capabilities, than from any specific defenses against an adequately mounted attack. This assumed margin of safety may be a matter of time alone.

In addition to military countermeasures against attacking planes, three important defensive elements are (a) a warning period of at least one hour to permit maximum utilization of gas masks or shelter protection and possibly other countermeasures; (b) detection of a BW attack through automatic detection and alerting devices and through the observation of cluster bombs or aerosol generators; and (c) normal medical facilities.

1.2 CHEMICAL WARFARE AGAINST MAN.

1.2.1 Types of Agents: A potential enemy is believed to be capable of launching a sustained attack against man with chemical agents. Those most likely to be used are the nerve gases and mustard gas.

1.2.2 Types of Attack: A covert attack with chemical agents in advance of an overt attack is unlikely. Both the nerve gases and mustard gas are agents that kill quickly, and both produce an easily recognizable syndrome that would disclose the existence of the attack. A saboteur would have to wear a mask in order to disseminate chemical agents as an aerosol.

After an overt attack, a covert attack with chemical agents would be possible but unlikely because of logistic difficulties. The agents would have to be obtained from home base.

1.2.3 Individual and Area Protective Devices:

Masks: The most effective individual protective device against attack by chemical agents is a suitable gas mask. The Army Chemical Corps is currently working on a mask that is effective in its protection against the most probable chemical agents, is capable of mass production, and is made of relatively inexpensive and suitable materials. It will be ready for final testing by July, 1952. This mask not only gives substantial protection against the toxic chemicals most likely to be used against man, but it also protects the respiratory system against the entrance of biological agents and radioactive particles. It is suitable for persons of school age and upwards.

The Army Chemical Corps also has under development a second, general use, civilian gas mask that will give adequate protection against all known war gases, but is more difficult to produce. A third and more rugged mask for civil defense personnel doing heavy work is also under development.

⁴ See Section 1.4, "Tactical Problems".

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Suitable protective devices for children under school age have not reached a satisfactory developmental stage. A bellows-and-hood-type device is under development and is about ready for testing, but its use would immobilize both mother and child. It would be better than nothing, but is far from satisfactory.

Protective Creams: Satisfactory protective agents in the form of creams are available against the cutaneous effects of the blistering agents.

Area Protective Devices: An impregnated panel is being developed for use as a diffusion barrier in windows and other openings. This material, which does not depend on forced ventilation for its effectiveness and which may be relatively inexpensive, offers considerable promise of giving substantial protection to individuals in properly sealed rooms. In addition, it may reduce the hazard from flying glass in the event of an atomic explosion. This material may be ready for pilot-plant production by mid-1953. Work on it should be continued; for it offers home protection not only for adults, but also for children for whom a suitable mask has not been developed.

A substantial amount of work has been done on anti-gas and anti-particulate filter systems for use in ventilation systems. Although these devices are still fairly expensive, they are quite practical for use in highly critical buildings. Their principal disadvantage is the fact that most existing air conditioning systems would have to be redesigned to incorporate fans of greater capacity if these filters are to be installed. This, of course, is not a serious problem in new construction.

1.2.4 Therapeutic Agents: Despite the effectiveness of masks and other protective devices, it is believed that widespread casualties would result from either a sustained or hit-and-run attack. Therefore, effective therapeutic agents must be provided.

Atropine in its derivative forms, is the major therapeutic agent against the nerve gases. To be most effective, it must be given very promptly *after* exposure and continued at intervals until the nerve-gas symptoms have subsided. Methods for the production of synthetic atropine exist, but the drug of commerce is derived from *Belladonna* and related plants or concentrates of these plants which come from Australia and Egypt.

The stockpile requirements for continued therapy of large numbers of cases are pure guesses, for the number of casualties that may require treatment and the dosage needed by each casualty will vary with the degree of exposure. It has been estimated that one out of three surviving nerve-gas casualties will be severe. Possibly six doses of 2 milligrams each of

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atropine will be required for the treatment of a severe nerve-gas casualty. Some will require more than this amount of atropine. It is suggested that an average of three doses of 2 milligrams of atropine will be required for the treatment of each mild or moderately severe casualty. Using these estimates, roughly 6,000 milligrams (8.0 grams) of atropine will be needed for the treatment of 1,000 nerve gas casualties. The market for atropine is somewhat "sensitive". Stockpiling of atropine has not been started.

1.2.5 Casualty Estimates: Although casualty estimates for CW and BW are difficult to make, these are urgently needed. They should be made for specific critical target areas, on the basis of population density, probable area coverage, attack and case-fatality rates.¹ These and atomic-bomb casualty estimates should be made at the local level and should be furnished to the Federal Civil Defense Administration to serve, together with other data, as a basis for current plans for Federal stock-piling of anti-biotics and other medical supplies.

1.3 RADIOLOGICAL WARFARE AGAINST MAN.

Radiological warfare can be carried out today against civilian populations. This weapon system probably would not be decisive in the enemy's hands at the present time, however, and would most likely be used as a weapon of harassment to deny or impede access to limited areas or materials, and to develop panic and confusion.

1.3.1 Types of Agent: RW makes use of the properties of some few radioactive forms of chemical elements that occur in nature or are man-made. These materials, when used as area contaminants, may introduce significant hazards through the continuous emission of radiation (primarily gamma rays) from the contaminated areas.

If radioactive materials were to be used primarily for the production of casualties, rather than as area contaminants, it is likely that they would be disseminated in a manner to facilitate their entrance into the body. The elements of choice would be alpha emitters that are not readily eliminated from the body.

The effectiveness of these agents depends markedly on the quantity of material distributed per unit area as well as on their half-life and the amount of radiant energy produced by each nuclear disintegration. In general, an element having a very short half-life would be ineffective over

¹ The Department of Defense should supply data through the Federal Civil Defense Administration on probable area coverage, attack and case-fatality rates.

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a prolonged period because of the rapid decay; and a long half-life element would have to be deposited in considerable quantity for the radiation during a short period to be large enough to constitute a real hazard.

1.3.2 Types of Enemy Attack: Radiological warfare could be carried out either overtly or covertly by the direct dissemination of contaminants, as discussed in the preceding paragraph, but covert use appears quite unlikely.

In addition to the direct use of RW agents, radiological hazards could result as a consequence of the use of the atomic bomb. Following an air burst there is a fall-out of the radioactive bomb debris. Since the fall-out pattern depends on the height of burst and the meteorological conditions, the distribution of these contaminants is normally not within the control of the user. In a surface burst or a shallow water burst, some of the area of blast damage obtained from burst at optimum height is sacrificed; but radiological contamination can be achieved at levels that constitute serious hazards.

1.3.3 Estimates of Enemy Capabilities: Radiological warfare agents may be produced by the direct use of neutrons for this purpose and also as a by-product in the production of fissionable materials for atomic bombs. Radiological warfare becomes increasingly probable as the production of neutrons increases. At the present time it is considered that an enemy would find it militarily more profitable to use his neutron sources to produce materials for bombs. RW is, however, a contingency that must be taken into account in the planning of civil defense, even though it is not now viewed as a major threat.

1.3.4 Estimates of Defensive Capabilities: According to present estimates, the greatest expected concentration of RW agents that might be delivered in any target area would not present any undue radiation hazard to man if evacuation were accomplished within 24 to a maximum of 36 hours. Monitoring squads, suitable for use in the event of atomic attack, will be adequate for detecting and surveying areas suspected of having become contaminated by radiological warfare agents.

For RW agents seriously to disrupt services and to be really effective in denying or seriously impeding access to contaminated areas it would be necessary for an enemy to deliver large amounts of the agent via costly carriers. Such delivery would be possible logistically but it is more likely that the carriers would be employed for other and more decisive weapons, except in very special circumstances.

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The public should be informed of the possibility of such attacks, and given full information as to how the effectiveness of the attack could be greatly minimized by each individual following the civil defense measures prescribed for this eventuality. A citizenry with knowledge of the effects, methods and control of RW would materially reduce the potential number of casualties from use of this weapon.

1.4 TACTICAL PROBLEMS.

There are several possible types of attack upon a major metropolitan area in which BW, CW and RW might be used in combination with other weapons. This report presents two of the types that appear to have the greatest potentialities: namely, combined atomic bombs and CW or BW attack; and, combined overt and covert CW and BW attack.

1.4.1 Combined Atomic Bomb and CW or BW Attack: An initial attack on a major metropolitan target area might consist of atomic bombs, delivered by airplanes or submarines, in combination with the clandestine use of BW agents against man immediately before the bombs land, and the clandestine use of both CW and BW agents immediately after. Such attacks could be launched on several metropolitan target areas at the same time.

Although an enemy conducting sabotage against man with CW agents would run serious risk of discovery, immediate pre-attack activities with BW agents might be carried on for several days. During this time, saboteurs could disseminate BW agents, previously prepared in this country and selected to produce illness or death *after* the overt attack. Principal targets would be military and civilian leaders located in such places as the Capitol, Pentagon, civil defense control centers, crucial industries and other vital centers. These people would be vulnerable to wet or dry aerosols introduced into unprotected ventilation systems, and to BW agents introduced into unprotected water and food systems. Another potential target is enclosed areas where large numbers of people normally congregate or would congregate on a "red alert".

Immediate post-attack activities could involve the use of both CW and BW agents. The production of nerve-gas casualties at that time would be feasible, because the prompt appearance of such casualties would not jeopardize any element of surprise and would create additional civil defense problems.

Such synchronized covert and overt attack would present major difficulties to an enemy for the following reasons:

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- (a) There is substantial probability that some of the saboteurs would be apprehended while preparing or distributing agents, and the "surprise" effect of the overt attack would thus be reduced.
- (b) A large number of saboteurs would need to know the places and time of attack well in advance, and an enemy would thereby run the considerable risk that this country would learn of the impending attack in sufficient time to strengthen its military and civil defenses and even to strike first if the evidence were overwhelming.

An attack not so well synchronized would be much less effective in its use of CW and BW agents but would still present serious secrecy problems to an enemy.

It is improbable that an enemy would attempt the concurrent overt use of CW gases or BW aerosols and atomic bombs on a single target area. The winds created by the atomic explosion and those created by primary and secondary fires would effectively dissipate most of the CW or BW agents present at the time of a burst. The winds would preclude the effective use of airborne agents for at least half an hour after the burst and probably longer. It is more likely that CW, BW, or RW agents would be used on targets 5 to 10 miles or more away from the atomic-bomb area.

It is possible but not probable that a single target would be attacked overtly by both atomic bombs and CW or BW agents within 24-48 hours. Such use of weapons would be wasteful; for any one, used alone, could cause sufficient damage to produce disruption of civilian activities.

1.4.2 Combined Overt and Covert CW and BW Attack: It is probable that an enemy could and would attempt the concurrent use of CW and BW agents in a combined overt and covert attack on a metropolitan target area. The multiplicity of agents used would complicate greatly the provision of medical care and the removal of any residual contamination. It is probable, also, that such attacks would be launched against cities that would normally be expected to give mutual aid or mobile support to other metropolitan areas that are being attacked with atomic weapons.

The clandestine activities could follow the pattern described in Section 1.4.1, except that less effort would probably be made to contaminate large public areas.

The great difference in this attack and that described in Section 1.4.1 is the absence of physical damage and casualties from atomic bursts.

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and the presence of gas or an aerosol of BW agents over a large portion of the target area. Under favorable meteorological conditions, these would persist for 30 minutes to several hours. Unless the population were properly protected, the casualties probably would be very high, and even with proper warning and protection they would be considerable.

Therefore, despite the difficulties that would be experienced by an enemy attempting clandestine use of CW, and particularly BW agents, covert attack is a sufficient threat that civil defense planning must continue to take it into consideration. Further, the necessary civil defense measures against overt attack can, in most instances, be adapted readily to meet both overt and covert attack with these weapons. Internal security constitutes a special problem and is briefly discussed in Section 1.5.1.

1.5 TACTICAL PLANS.

1.5.1 **Internal Security.** Any sudden outbreak or intensification of sabotage activities against man, animals or crops or any other calls for marked intensification of internal security measures by agencies familiar with the technical possibilities of CW, BW and PW agents. Particular attention should be given to the production of air, water and food in installations housing key personnel and industries. Just as there are military measures precedent to a manageable civil defense, so too, are there internal security measures precedent to a manageable civil defense.

Only through close liaison among the agencies with clearly assigned technical and security responsibility can internal security measures precedent to a manageable civil defense be carried out.

1.5.2 **Preventive Measures.** Casualties from chemical or biological attack can be reduced approximately 90 per cent by the development of a proper civil defense. One of the most important elements in holding down the number of casualties is the use of a gas mask. After a date to be jointly determined by the National Security Council and the Federal Civil Defense Administration, each person in critical target areas should possess a suitable mask and keep it in his possession constantly.

Masks are a more practical means for providing widespread protection for many people than are gas-and-particle-proof shelters. Masks can be available readily regardless of the individual's location. They can be sold, and the costs thus distributed among individual users. Large ge-

** It is probable that most individuals will give more careful attention to the purchase and proper use of their masks if they pay for them.*

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and-aerosol-tight shelters may be susceptible to internal contamination by saboteurs and damage by atomic blasts, but some such shelters are needed for the treatment of gas casualties immediately after a gas attack.¹

Masks are uncomfortable and hamper a person's ability to carry out useful work. A system should be devised that will enable people to wear them as little as possible. This is particularly important for civil defense personnel and for others doing heavy work.

Gas masks should be put on immediately whenever a "red alert" is sounded, whether for the initial or subsequent attacks. They should be kept on until the "all clear" is sounded or official instructions are given for their removal.

The "all clear" should not be sounded until both of the following conditions obtain: (1) all enemy craft have been cleared from the area, and (2) the outdoor air has been monitored and found safe. Even then, masks should be removed only *after* their wearers leave a building or shelter area. Large shelter areas may have been contaminated by saboteurs. Small shelters can be assumed to be clear if there has been no overt CW or BW attack. Gas, being heavier than air, will tend to collect and persist in sub-surface shelters if there has been an overt CW attack. CW and BW agents dissipate more slowly in buildings than in the outside air.

Information concerning removal of masks prior to the "all clear" should be communicated to the public by radio broadcast and by civil defense personnel. However, because of the possibility that a CW or BW attack might be launched after the air has been officially declared safe, the Federal Civil Defense Administration siren warning system should be modified to include a distinctive signal indicating that masks should be put on again.² This action must be taken very promptly, and warning to that effect could not be given rapidly or completely enough by radio or by civil defense personnel.

Consideration should also be given to the use of this distinctive signal to confirm to the public the existence of an overt BW or CW attack.

1.5.3 Detection, Identification and Control: There is no detection system at present that could give prompt and reliable warning of an imminent CW, BW or RW attack, nor does it appear that a reliable system can be developed in the near future. The use of ground observers and radar to observe the tactical maneuvers of airplanes or vessels near target areas

¹ Large communal shelters should be used as little as possible for these and other reasons brought out in PROJECT EAST RIVER reports.

² See PROJECT EAST RIVER Report, Warning and Communications.

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would give only presumptive evidence of such attack, and this only a few seconds to minutes before the agents are released on the population.

The use of physical and chemical instruments for the detection of chemical and biological agents, once they have been released, has the advantage of giving fairly reliable evidence, but has the disadvantage of furnishing the information only after numerous individuals had been exposed to the noxious agents. These agents would probably come in contact with many people between the point of release and the detection devices, even if the devices were automatic and very closely spaced.

Monitoring squads suitable for use in the event of an atomic-bomb attack will be adequate for deterring and surveying areas suspected of having been contaminated by RW agents. This subject is discussed in Part III of the PROJECT EAST RIVER Report, *The Destructive Threat of Atomic Weapons*.

It will be important to monitor the air for CW or BW agents after any real or suspected overt or covert attack with these agents. Water and, in certain circumstances, food also will have to be checked.

Air: Developmental work on automatic, rapid gas-detection and identification devices is progressing satisfactorily. Acceptable gas detectors can be produced now at an economically feasible amount per unit, and this unit price probably could be halved by mass production. Field versions of the automatic gas detector also are under development and may be available for production in the relatively near future. The Army Chemical Corps field kit is quite satisfactory for the rapid, non-automatic detection of other war gases less likely to be used.

Rapid detection and identification instruments for BW agents are under development, but these are far from ready for production. Much additional work is needed on such instruments as particle size and number counters, protein detectors, spectroscopic instruments and membrane filters, before it will be possible to monitor the air for BW agents with sufficient speed to furnish practical information concerning the time to put on or take off gas masks. Marked intensification of research in this area is needed.

Water: Water will need to be checked, not only for CW and BW agents but also for possible contamination from such sources as broken mains and sewer lines. Rapid checks can be made for CW agents; and, if these are absent, the water can be declared to be safe after boiling, proper chlorination, or other chemical treatment until the more time-consuming checks can be made for BW agents. Special membrane filters make it possible to detect most bacterial agents within 24-36 hours. These filters are not presently helpful in detecting viruses and toxins. Nerve gases present

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no major hazard in water since they hydrolyze very rapidly and are destroyed by proper chlorination. Mustard gas would cause serious trouble if introduced into a water distribution system, but is an agent unlikely to be used because of logistic problems.

Overt attack with CW or BW agents probably is not a great hazard to a metropolitan water system that is operated according to normal peacetime standards.⁹

Food: The protection of food from covert attack is primarily a problem of internal security. It is impractical to monitor all foods. Mustard gas usually can be detected by its odor, and food contaminated with it should be discarded. Properly cooked foods are safe even if previously contaminated with nerve gas, or BW agents.

Most uncooked, non-fatty foods contaminated with nerve gases, will be safe for consumption after twenty-four to forty-eight hours of airing. Small lots of uncooked food suspected of BW agent contamination should be discarded. Large lots can be checked within 3-4 days by usual laboratory procedures.

Detection by Public: The public should be familiar with the signs and symptoms of nerve-gas poisoning. If these should develop, the fact should be reported to the nearest civil defense official.

1.5.4 Early Treatment:¹⁰ Atropine is essential in the treatment of all nerve gas casualties and many victims will need artificial respiration. To be effective, atropine must be given very promptly after exposure. The supply stored in warehouses and physicians' offices will be of relatively little value for the initial dose because it could not be reached in time. Prior to any attack, a syringe or ampin containing a milligram of atropine should be made available to each resident or worker in critical target areas. This could be used for the initial therapeutic dose by the casualty or be given by any person near him. A second and third dose, also, could be given by an untrained person; subsequent doses should be given only by a trained person.

Severe nerve-gas casualties are likely to require artificial respiration. However, the manpower that would be needed to render such service would create a demand that is beyond the probability of fulfillment. There is a need for an effective, mechanical, easily transported device that

⁹ See PROJECT EAST RIVER Report, Health and Welfare.

¹⁰ See PROJECT EAST RIVER Report, Health and Welfare.

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would enable a few persons to meet the respiratory needs of many victims. The device should be capable of manual or power operation, singly or in multiple units. Its primary use would be in first aid stations; a suitable field device is highly desirable, but much less practical. The Department of Defense is working on group artificial respiration devices, but immediate attention is being given to civilian application.

If certain BW agents are used, the early prophylactic use of antibiotics will save many lives. There should be close liaison, therefore, between the medical care and public health personnel. Early detection and identification of the agents used, and the determination of their reactions to antibiotics are of the utmost importance.

1.5.3 Decontamination: The major problem in this field is the rapid dispersion or neutralization of aerosol or gaseous clouds after onset of attack. Thus far, only negative results have been obtained from stores to develop practical measures to accomplish these ends. Further study is needed on methods for the dispersion or neutralization of such clouds covering large areas because of the crucial importance of reducing the time of exposure. It is emphasized that this problem requires research for new knowledge, not merely the development and application of existing principles.

The decontamination of people and objects is not expected to be an extensive problem. Mustard gas is an unlikely agent for use against the United States because it presents serious logistic problems, and nerve gases are relatively non-persistent. People contaminated with liquid nerve gas, however, will need very prompt decontamination. Most BW agents will leave little contamination, for many of the organisms that probably would be used are relatively fragile. Those that are more hardy and persistent will tend to attach to other particles or to each other and thus form units too large for penetration of the lungs, the most effective portal of entrance for many agents.

1.5.4 Special Emergency Research: Teams of scientific observers are needed to gather data at the time of an overt attack, so that an evaluation can be made of the nature of special weapons used against the United States, the effectiveness of such CW, BW, and KW weapons as may be used, and the effectiveness of our civil defense countermeasures. Four or five highly specialized teams located strategically about the country would be sufficient, but they should have no other responsibility during attack and immediately after. They should work with local civil defense personnel in each target area during the pre-attack period to establish a grid pattern of sampling stations for CW, BW, and KW agents, and to work out methods for analyzing the casualty data after attack in the light of their observations.

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Each target area should assign local technical personnel to help collect and analyze the necessary data. The highly specialized teams should also gather information on the organizational efficiency of the local and other civil defense health personnel before, during, and after attack, the availability of equipment and supplies, and other matters pertinent to civil defense functioning in the special weapons field.

Without pre-assigned teams of scientific observers, the opportunity to make many valuable observations that possibly would save thousands of lives in future attacks would be lost.

1.6 PERSPECTIVE ON BW, CW AND RW AGAINST MAN.

1.6.1 Balance of Peace and War Directed Research: Basic research in the biological sciences is a part of our day-to-day war upon cancer, infectious diseases, and other maladies that kill millions of our people before they have lived a normal life span. Such basic research may well contribute much to our civil defense program, and civil defense biological research may make contributions to peacetime problems. It is important that proper balance be maintained between the battle against our more commonplace enemies and our preparations for forms of attack that may never come. As indicated earlier, some specific increased efforts in the development of suitable defenses are needed, particularly against overt attack, but our normal programs of public health and medical care are in themselves an important defense.

1.6.2 Public Information: Chemical, biological and radiological warfare are subjects peculiarly susceptible to exaggeration, distortion and rumor. Civil defense authorities have an obligation not to augment unnecessarily the anxieties and fears of citizens.

Theoretically, living matter can be modified to produce forms with unusual properties, but the presumption against the sudden appearance or development of such new organisms is strong, particularly to the extent of their confounding known diagnostic, immunologic and therapeutic procedures. New and strange chemicals are more probable than new life forms, but again there is currently no reason to suspect that the enemy has perfected agents unknown to us. The dangers from radiological weapons have been overestimated by many lay persons.

Civilians need a realistic appraisal of the general threat and of the limitations of chemical, biological and radiological warfare. They need, too, understanding of the actions they can take for their own protection as well as of those being taken in their behalf by civil defense and other personnel. They should realize that the effectiveness of attacks against people

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with chemical, biological and radiological weapons can be greatly minimized if the prescribed civil defense program is followed and protective devices are used as recommended. Only by furnishing the public with realistic information and guidance can this country, in time of emergency, count on its most important national resource—an enlightened and responsive citizenry.

1.7 CONCLUSIONS AND RECOMMENDATIONS.

Man is vulnerable to attack by biological, chemical and radiological agents. Their use against him will be determined by the objectives an enemy hopes to accomplish, by the availability of the weapons, and by the problems to be overcome in their use. The enemy's capability for BW and CW constitutes a *real* threat to man; but the use of RW agents at this time is unlikely. If the latter were used, their principal function would be to deny or impede access to limited areas, and undue radiation hazard would not result if evacuation were accomplished within twenty-four hours. Monitoring squads suitable for use in the event of atomic-bomb attack will be adequate for detecting and surveying areas suspected of having become contaminated by radiological warfare agents.

The number of primary casualties resulting from overt use of properly distributed BW or CW agents could be large enough to cause enormous difficulties. Covert attack with BW agents could cause serious disruption among selected local population groups. It is most improbable that extensive, secondary spread of cases will occur following use of BW agents, if our public health and medical care systems are relatively intact. However, the possibility of seriously overloading these systems by atomic, CW or BW attack must be kept in mind.

The effects of overt attacks by chemical, biological and radiological warfare against man could be reduced approximately 90 per cent by:

- (a) Sufficient warning of overt attack (1 hour).
- (b) Early detection of CW or BW attack and provision for prompt information to the public.
- (c) Proper protective devices (*masks and shelters*)
- (d) Proper individual understanding of action expected of each person.
- (e) Proper preparation of health personnel and the availability of certain medical supplies.

The accomplishment of these objectives will require a major effort. Even though the number of casualties can be greatly reduced by adequate defensive measures, substantial numbers would still occur and there should be ample preparation for their care.

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In the absence of reliable intelligence to the contrary, defensive activities until July, 1954 should be primarily of a preparatory nature, revolving largely around necessary research and development. Planning and organization of operating functions, as well as some production and stocking of materials, are also needed.

The second phase of preparation, during which materials and equipment would be made available to the public, would begin on a date to be determined by appropriate authorities. The costs of adequate preparation, though substantial, are small when compared with the potential loss which could take place in an unprepared population. In fact, the differential is so great that failure to set up and meet this kind of a time schedule would jeopardize unnecessarily the lives of our citizens and compromise the outcome of a war. The civil defense measures recommended could so minimize the results of biological, chemical and radiological agents as to render their use on a major scale against the people of this country relatively unprofitable to an enemy and hence less likely.

Specific conclusions and the resulting recommendations are grouped generally in the order of priority in which the Panel believes that action should be taken.

1.7.1 Civilian Masks for Adults and School Age Children: A cheap, mass-producible, single-use gas mask that gives substantial protection against respiratory tract access of BW and RW agents and the most probable CW agents is under development for persons of school age and above. It will be ready for testing by July, 1952.

Recommendations:

- (1) That the adult civilian gas masks presently being developed, which offer substantial protection against the most probable war gases and the respiratory effects of biological and radiological agents, be tested jointly by the Army Chemical Corps and the Federal Civil Defense Administration and, if found acceptable, be standardized for production at once.
- (2) That the Federal Civil Defense Administration determine immediately its future requirements for masks and promptly request from Congress authority and a working capital fund for their procurement and sale.
- (3) That the Federal Civil Defense Administration, using the Army Chemical Corps as its purchasing agent, procure the necessary masks for resale at cost to those desiring to purchase.

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chase them. An initial lot of 70,000,000 should be procured on a phased schedule and should be available in the warehouses as of July, 1954.

- (4) That the Federal Civil Defense Administration, in consultation with the National Security Council, determine the time when such masks should be made available for purchase by the public.*
- (5) That priority on the purchase of masks be given to people in critical target areas. State and local civil defense organizations should be the distribution channels. Proper instruction on the preservation and use of the mask should be given to each purchaser by local civil defense personnel. Every effort should be made to sell rather than to give these masks to prospective users, because a purchased article is more apt to be retained than is one that is free.*

1.7.2 Civilian Masks for Special Groups: A type of mask for infants and pre-school children is under development, but the present model would be difficult to use. A protective device of a different kind, namely, an impregnated panel for use in windows offers substantial promise. If suitable protection for children were known to be available, the effect on morale would be excellent.

A mask suitable for civil defense personnel doing heavy work is under development. No protective clothing is being developed specifically for civil defense personnel.

Developmental work on anti-gas-and-particulate, forced-air filters is progressing rapidly. Impregnated panel, diffusion type filters sufficiently simple for widespread use in homes may be available late in 1953.

Recommendations:

- (1) That the Federal Civil Defense Administration request the Army Chemical Corps, in collaboration with appropriate contractors, to prosecute vigorously research designed to develop a suitable cheap, mass-producible, anti-gas and anti-particulate mask and area protective devices for infants and pre-school children. This research should be financed by the Federal Civil Defense Administration.*
- (2) That the Federal Civil Defense Administration, in collaboration with the Army Chemical Corps, test the feasibility of*

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utilizing standard military anti-gas, protective clothing for civil defense workers doing hard work. If not feasible, research in this field should be intensified.

- (3) That (a) development of diffusion type filters be intensified and, when acceptable, be made available for purchase by the public, and (b) that suitable filters be installed by July, 1954, in a limited number of buildings where there are concentrations of highly important personnel critical to the defense effort.*

1.7.3 Tactical Requirements: It is essential that methods be developed for: indicating at the earliest possible moment imminent or actual overt BW or CW attack; identifying the nature of the attack; dispelling or neutralizing the agent; determining the safety of removing gas masks; providing prompt treatment for casualties; and, when necessary, warning the population to put on masks a second time.

It is important to know when masks should and should not be worn, for they seriously hamper activities.

Developmental work on rapid automatic gas detection and identification devices has progressed to the point where production may soon be feasible, but few local civil defense organizations have made plans for their use. The development of rapid BW aerosol detection and identification devices has not progressed to the point where production is feasible.

Recommendations:

- (1) That the Federal Civil Defense Administration request the Department of Defense and the Public Health Service to intensify their development and evaluation of air and water sampling techniques for use in the event of CW and particularly BW attack, with the view of obtaining rapid automatic detection and identification of the agent employed. Among the instruments needing further development are: particle-size and number counters; protein detectors; spectroscopic BW identification instruments; membrane filters; gas samplers.*

Much of this research should be financed by the Federal Civil Defense Administration.

- (2) That the Department of Defense and the Federal Civil Defense Administration jointly carry on developmental and*

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operational research on the development of an efficient, rapid detection and warning system that will indicate imminent or actual overt attack with CW or BW agents. This system might include: the use of automatic gas and BW aerosol detectors (see preceding paragraph); civil defense observers and Air Force ground observer corps on the periphery of the target area. Each detection system should be tied in with the siren warning device.

- (3) That the Federal Civil Defense Administration request the Army Chemical Corps and the Public Health Service to study methods of neutralizing or dissipating aerosols of biological agents covering large areas.¹¹*
- (4) That the Federal Civil Defense Administration request the Department of Defense, in collaboration with appropriate contractors, to prosecute vigorously research on the development of an inexpensive, readily transported, manually and/or power operated, mechanical, artificial respiration device for civilian use, and capable of being used singly or in multiple units. This work should be coordinated with the developmental work on a comparable military device.*
- (5) That civilians put on gas masks at the sounding of the "red alert" for each attack, and keep them on until the air is officially declared safe.*
- (6) That the Federal Civil Defense Administration alter its siren warning system to include a short distinctive signal indicating overt attack with BW or CW agents. On hearing the signal, civilians should put on their masks and await further instructions from their warden or by radio.*

¹¹ Such investigations should be coordinated with research proposed in "Program I" of Appendix III—A of PROJECT EAST RIVER Report, Thermal Radiation Attenuation Clouds. Though such studies are perhaps most important in terms of BW against man, they may also be useful in attacks against animals and crops.

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1.7.4 Special Emergency Research: Valuable observations that conceivably could save thousands of lives in future attacks will be lost unless specific scientific teams are assigned to gather such data.

Recommendations:

That the Federal Civil Defense Administration, through the Department of Agriculture, Department of Defense, and the Public Health Service jointly establish means of scientific observers in strategic locations throughout the country to evaluate the following factors:

- (1) The nature of special weapons used against the United States of America.*
- (2) The effectiveness of such BW, CW and RW weapons as may be used.*
- (3) The effectiveness of our civil defense countermeasures.*

1.7.5 Decontamination: In view of the nature of anticipated agents, decontamination is not expected to be an extensive problem. Some decontamination of people and objects may be necessary.

Recommendations:

That the Department of Defense and the Federal Civil Defense Administration examine jointly the feasibility of adapting military decontamination methods to civilian use.

1.7.6 Research on Immunization, Early Diagnosis and Treatment: There are many potential BW agents, but suitable vaccines are not available for all. It will be impracticable to utilize such vaccines except after highly reliable intelligence reports indicating the enemy's intentions with respect to a given agent, or after actual attack. Even then immunization may be administratively impracticable except for certain key personnel or in certain localities. Early diagnosis and treatment is essential.

Recommendations:

- (1) That research be carried out on vaccines against some of the biological agents most likely to be employed by the enemy and that production of these be undertaken on a pilot-plant and stand-by basis.*
- (2) That the Federal Civil Defense Administration, through the Public Health Service, the Department of Defense*

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and other competent agencies, continue to sponsor research directed to the following objectives:

- (a) Better and quicker methods of isolating disease-producing agents, from patients and identifying them, particularly some of those less commonly encountered.
- (b) Means of diagnosis of disease while the victim is still in the incubation period, or the first 24 hours of illness.
- (c) The uses and capabilities of therapeutic agents during the incubation period of those diseases believed most likely to be used by an enemy.

1.7.7 Internal Security: The prevention of sabotage with BW agents is largely a matter of internal security. Just as there are military measures precedent to a manageable civil defense, so, too, are there internal security measures that are precedent to a manageable civil defense.

Recommendations:

That the Federal Civil Defense Administration and governmental agencies to whom operational responsibility is delegated, or whose services are being used by the Federal Civil Defense Administration, continue and intensify their liaison with the agencies of the Government responsible for internal security to the end that:

- (a) *The internal security agencies may be aware of the technical problems involved in sabotage with chemical, biological and radiological weapons, and*
- (b) *The Federal Civil Defense Administration and other agencies may be aware of the time and location of probable sabotage activities.*

1.7.8 Local Preparation: Local organization and training of personnel to meet the special problems imposed by the use of BW, CW and RW agents is lagging.

Recommendations:

- (1) *That the problems posed by the possible use of these unconventional weapons be brought to the attention of physicians and other health personnel on a continuing basis but in such manner as not to alarm the civilian population unduly.*

¹² See PROJECT EAST RIVER Report, *Health and Welfare*.

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- (2) That the Federal Civil Defense Administration in collaboration with other governmental and private agencies, accelerate the publication of manuals for the guidance of hospital and health personnel on the preparations necessary to minimize the effects of BW, CW and RW attacks against man.
- (3) That the attention of public health officials in target areas be directed to the importance of maintaining adequate chlorination and other purification processes, along established lines, for the protection of water supplies against BW, CW and RW attack.
- (4) That the Federal Civil Defense Administration make funds available to the Public Health Service for the training in biological warfare defense of epidemiologists, laboratory personnel, sanitary engineers, and other specialized personnel from states and localities.
- (5) That health departments in urban areas be encouraged to bring the epidemiological intelligence activities¹² to a state of proficiency that will assure:
 - (a) Readily available laboratory services for the identification of ordinary and extraordinary infectious agents.
 - (b) Prompt reporting of cases of infectious disease by hospitals and practicing physicians.
 - (c) Adequate personnel and facilities for the prompt investigation of outbreaks of disease.

1.7.9 Public Information: Members of the public can be expected to respond in an enlightened manner during an emergency only if they possess basic information about the nature of weapons used against them.

Recommendations:

That the Federal Civil Defense Administration maintain leadership in, and intensify the efforts to furnish civilians with a realistic appraisal, without the use of scare techniques, of the general threat and limitations of biological, chemical and radiological warfare; advise them as to the actions they can take to minimize the effects of attack; and give general information concerning the steps taken for the protection of the public by professional and civil defense personnel.

¹² These are but normal functions of modern health departments. To what extent these improved practices should be regarded as specifically for civil defense, in the narrower meaning of the term, is difficult to say.

1.7.10 Casualty Estimates and Supplies: Casualty estimates based on a "typical" American city have served as the basis for some local planning and for the Federal stock-piling of medical supplies. Such general casualty estimates are not, however, an adequate basis for definitive planning of local health services.

In general, the Federal stock-piling of medical supplies is being well phased, except that atropine, which is essential in the treatment of nerve gas casualties and must be given promptly, is not yet being procured.

Recommendations:

- (1) *That the local civil defense personnel make estimates of CW and BW casualties by specific target areas, taking into account population density, probable area of coverage, and attack and case fatality rates.¹⁴ These estimates should be furnished to the Federal Civil Defense Administration and used along with other data in refining estimates for medical supplies to be stock-piled.*
- (2) *That additional funds to implement the Federal Civil Defense Administration stock-piling program for antibiotics and other medical supplies and equipment be provided promptly. The Federal Civil Defense Administration 1953 budget estimate for this purpose was realistic, but most of it was disallowed.*
- (3) *That the Federal Civil Defense Administration develop its procurement of atropine on the basis of 8 grams per 1,000 gas casualties and that stock-piling of this item be started at once.*
- (4) *That the Federal Civil Defense Administration:*
 - (a) *Develop and test methods of distributing one ampin or syrette of atropine to each individual in critical target areas, together with instructions for its care and use, and*
 - (b) *That atropine be distributed to all individuals in critical target areas at a time jointly determined by the National Security Council and the Federal Civil Defense Administration.*

1.7.11 Clarification of Federal Responsibility: There is no clear delineation of authority and responsibility in this field between the Fed-

¹⁴ *The Department of Defense, through the Federal Civil Defense Administration, should furnish the probable area of coverage, attack and case fatality rates.*

eral Civil Defense Administration and the Public Health Service. Determination that any particular outbreak is the result of biological warfare may be greatly delayed or perhaps never firmly established because of the clandestine nature of the attack. It is imperative that the Public Health Service be prepared, in any event, to take countermeasures in concert with the states.

Recommendations:

- (1) *That the Federal Civil Defense Administration and the Public Health Service collaborate in planning the Federal operational activities necessary for minimizing the effects of outbreaks of disease among humans, produced by enemy action.*
- (2) *That the Federal Civil Defense Administration delegate¹³ to the Public Health Service responsibility for carrying out such Federal operational activities and retain the responsibility for coordinating the civil defense efforts of the Public Health Service with those of other agencies.*
- (3) *That the Federal Civil Defense Administration retain operational responsibility for the medical care of casualties.*
- (4) *That the Federal Civil Defense Administration maintain cognizance of the Department of Defense programs on BW, CW and RW.*

1.7.12 Re-examination of Civil Defense Research: Research devoted to the study of peacetime diseases of man may well contribute much to the civil defense program, and civil defense biological research may make contributions to peacetime problems.

Recommendations:

That the National Academy of Sciences appoint a panel of civilian and military statesmen-scientists to re-examine, at least annually, the extent of research devoted to the prevention and treatment of human disorders caused by CW, BW and RW, and to report to the public the proper balance of effort that should be maintained between the battle against the more commonplace diseases of man and the preparation of defenses against enemy attack.

¹³ This does not mean that the Public Health Service would assume the functions of state and local health and medical organizations, nor the Federal Bureau of Investigation's responsibility for internal security.

2. ANIMALS

2.1 BIOLOGICAL WARFARE AGAINST ANIMALS.

Domestic livestock are vulnerable to BW attack with agents, which even though used in small quantities, are capable of causing epizootics of damaging proportions. The animals of importance are cattle, swine, sheep, goats, and poultry.

The purposes of a BW attack against animals would be to reduce vital supplies of meat, poultry products, dairy products, medicinals and pharmaceuticals of animal origin and animal by-products of all kinds; to cause an expenditure of manpower, materials and supplies in efforts to prevent the attack or to minimize its effects; to cause disruption of transportation and other elements of the economy as a result of the necessity of imposing quarantines; and to cause political problems as a result of embargoes.

It is unlikely that BW attack would be directed against horses and mules, pet animals, zoo animals, fur-bearing animals, or wild animals. However, the possible involvement of such animals cannot be entirely ignored because of their becoming potential carriers of infection to other animals and to man.

2.1.1 Types of Agent: There are agents possessing most of the characteristics that would be useful in pressing an attack. Some of the desirable characteristics of an agent for BW against animals would be: (1) high pathogenicity; (2) a high degree of contagiousness from animal to animal and from herd to herd; (3) resistance to the destructive forces of nature such as sunlight, heat, cold and drying; (4) capability of producing a high death rate, or lasting debilitating effects and loss in productivity; (5) economic feasibility of production in adequate quantities¹; and, (6), capability of being delivered to the target without undue loss of effectiveness.

There follows a list of agents that might be selected, together with a discussion of their possible effectiveness and the specific protective devices to be used against them.

The Virus of Foot-and-Mouth Diseases. This is a foreign disease, of which there are at least six distinct immunologic types and many variants within these types. It affects domesticated and wild ruminants and

¹ These quantities would be minimal for covert attack.

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swine, with morbidity of nearly 100 per cent. The mortality rate varies from 5 per cent to 50 per cent with highest rate among young animals. The disease spreads rapidly from animal to animal and from herd to herd. Means of contagion include contact with infected animals, infected animal products, contaminated premises, hay, and other objects. The disease produces marked loss of weight, greatly reduced milk flow, debilitating complications—such as mastitis, abortion, sterility, impaired heart action—and general unthriftiness. It does not occur in this country, consequently there is no immunity in our livestock.

There is no specific treatment. Preventive vaccines are of extremely variable effect and of short duration. Vaccination is complicated by the several types and variants of the virus. Polyvalent vaccines have not been generally successful. The virus is not resistant to sunlight, heat, drying, and disinfectants, but it can be preserved for long periods by freezing.

The disease is extremely difficult to differentiate from vesicular stomatitis and vesicular exanthema (both diseases occurring in this country) in the initial outbreaks.

The Virus of Rinderpest: This, too, is a foreign disease. It affects cattle and buffalo; other ruminants and swine are much less susceptible. So far as is known, there is only one immunologic type. Morbidity is extremely high and mortality runs 75 per cent or higher. The disease spreads rapidly from animal to animal and from herd to herd in the same manner as foot-and-mouth disease, although not so rapidly as the latter. It does not exist in this country, consequently our livestock have no immunity. Four types of vaccines are being used to some extent, but more information is needed as to their effectiveness and safety. The virus is relatively easily destroyed by sunlight, heat, drying, and disinfectants. There is no specific treatment for the disease.

The Virus of Fowl Plague (Fowl Pest): A foreign disease, Fowl Pest affects principally chickens and turkeys. Only one immunologic type is known. It is highly contagious with morbidity and mortality often reaching nearly 100 per cent. Transmission from bird to bird and from flock to flock is rapid and by the same means as foot-and-mouth disease virus, but it is not so likely to spread quickly to epidemic proportions. The virus is relatively easily destroyed by sunlight, heat, drying and disinfectants. No specific treatment is known. There is no vaccine available that has been field-tested. The disease does not occur in the United States so there is no natural immunity.

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The Virus of Newcastle Disease (Asiatic or Other Highly Virulent Foreign Strains): Affects barnyard fowl and game birds such as pheasants and partridges. Although there are foreign strains of the virus that are highly fatal, these are apparently immunologically similar to our domestic strains; therefore large numbers of birds in this country are presumed to have acquired resistance. The disease spreads rapidly from bird to bird and from flock to flock in the same general manner as foot-and-mouth disease. No specific treatment is known; but vaccines, widely distributed in this country are at least partially effective as preventives. The virus is relatively easily destroyed by sunlight, heat, drying and disinfectants.

Other Agents: There are, of course, other animal and poultry disease agents that must be considered—involving other foreign diseases as well as diseases native to this country—such as *Bacillus anthracis*; the viruses of East African swine fever, hog cholera variants, Teschen disease, Rift Valley fever, and rabies; and *Erysipelothrix rhusiopathiae*.

2.1.2 Types of Enemy Attack: An attack could be made effectively either by sabotage or by an overt act of war. The choice of an agent would be influenced not only by the objectives of the attacker, and by his technical competence but also by the pattern of husbandry established in this country for the classes of livestock involved. The known (or supposed) preparation of the country relative to averting or minimizing an attack, and the manner in which an attack with the agent would have to be carried out, would also be determining factors. In general, however, an epizootic of large proportions could easily spring from a very small but strategically located introduction of a suitable disease agent.

The task of an enemy would be made simpler by the fact that livestock movements in this country are markedly greater than in other parts of the world. Young animals raised on the Western ranges are moved to pasture in the Northwestern or Southeastern States and then sent to feedlots in the Middle West or elsewhere, and finally to the large packing centers for slaughter. The pattern varies with the different classes of livestock and the localities in which breeding, grazing and feeding-out are concentrated. In general, however, much of our livestock moves for considerable distances overland, coming into contact with other animals while being transported by rail or truck and while passing through one or several livestock markets, public stockyards, sales barns, and similar places.

2.1.3 Estimate of Enemy Capabilities: Enemy capabilities for waging biological warfare against animals, either overtly or covertly, are similar to those for directing such warfare against man.² The only signifi-

² See Section 1.1.3 (Man), "Estimate of Enemy Capabilities".

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cant difference is in the safety factor; biological agents for use against animals can be prepared and administered with relatively little hazard to operating personnel.

2.1.4 Estimate of Defensive Capabilities: In keeping with the principle of maximum utilization of existing governmental resources, the Federal Civil Defense Administration has requested the Department of Agriculture to use its facilities for the protection of animals against biological, chemical, and radiological warfare agents. In some instances, however, the division of responsibility for operational activities and research activities between the Federal Civil Defense Administration and the Department of Agriculture remains unclear.

In responding to the request to devise measures to protect livestock against BW attack, the Department of Agriculture assigned the task to the Bureau of Animal Industry of the Agricultural Research Administration. No special funds have been allocated for this work, except that a limited sum was made available to the Department of Agriculture by the Federal Civil Defense Administration in fiscal year 1952 to stock-pile a few scarce items for vaccine production.

The Bureau of Animal Industry has taken a number of steps, in cooperation with state livestock sanitary authorities, to minimize as much as possible the effects of any BW attack on animals. In the following discussion of these measures, references to Federal and state agencies should be construed to mean the Federal Bureau of Animal Industry and the appropriate state livestock sanitary authorities.

Prevention of Introduction and Spread of Disease: Federal personnel engaged in inspection and quarantine supervision of imports of animal foods and other materials to protect against accidental introduction of animal diseases have been cautioned to give attention, also, to the possibilities of planned introductions of infectious material. Help in this regard is given by officers of the Bureau of Customs, the Public Health Service, the Bureau of Entomology and Plant Quarantine, and the Immigration and Naturalization Service. No additional personnel have been assigned to inspection and quarantine work for this purpose, and this service cannot be relied upon to do more than reduce the danger of *planned* introduction. No measures have been taken to supervise or inspect diplomatic shipments.

The Bureau maintains close liaison with the Central Intelligence Agency, the Department of Defense, and the Department of State, in order to obtain and evaluate information from foreign sources.

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Federal and state livestock sanitary officials in each of the states and territories have been informed and cautioned to be alert to prevent livestock introduction and spread of disease, and are being offered assistance in diagnosis and the initiation of prompt quarantine, eradication and control measures.

Manufacturers of veterinary biologics in interstate commerce have been cautioned to exercise care in screening employees whose duties provide them with an opportunity to contaminate such products. State agencies have been requested to take similar action with respect to manufacturers of veterinary biologics in intrastate commerce, and also with respect to prepared feeds. More careful checking of biologics, in so far as personnel and facilities permit, is being encouraged. The Food and Drug Administration has Federal jurisdiction over the interstate movement of feeds. The problem of protecting feeds from purposeful contamination has been discussed with officials of that agency; however, there is no inspectional control over these products such as there is with respect to biologics, nor does such inspectional control appear to be practicable.

The Federal Civil Defense Administration has been requested to and has included in its budget for the fiscal year 1953, an item of \$175,000 to be transferred to the Bureau of Animal Industry for additional inspectional control of the manufacture of veterinary biologics in interstate commerce.² Present control measures are considered adequate to protect against accidental contamination, but additional control is necessary to give reasonable protection against planned contamination.

Prompt Detection of a Disease Outbreak: It is essential that a system be maintained whereby the occurrence of a foreign animal disease or any unusual outbreak of an animal disease already present in this country will be detected and reported immediately to responsible authorities so that the condition can be identified and the proper action taken.

The importance of early discovery of the disease cannot be over emphasized. Delay at this point may mean that countermeasures will be too late and that long-drawn-out and costly control measures will have to be substituted for more effective and economical eradication procedures.

Since a BW attack may be made as a covert act of sabotage, and since the principal agents in this field are viruses, it is unlikely that any warning of the attack will be received before animals begin to succumb to the disease. Accordingly, effort has been made through the press, radio, and distribution of leaflets to inform the entire livestock community, including owners, shippers, dealers, veterinarians, county agents, and others, regarding the possibilities of BW attack, the most likely agents to be used,

² The 1953 appropriation to FCDA was so far below its request that transfer of funds to Bureau of Animal Industry is most unlikely.

characteristics of the foreign diseases with which they are unfamiliar, and the identity of state and Federal personnel in each area who should be notified in case of an outbreak of a foreign disease or an unusual spread of one of our domestic diseases. Such information has stressed the critical importance of prompt discovery and the rapid reporting of the infection.

State and Federal agencies have veterinarians and assistants stationed in all parts of the livestock-raising areas of the country. The concentration of such personnel varies, of course, according to the density of the livestock population, the current animal disease control programs, and other activities in the several states.

The Federal veterinarians and their assistants check the livestock passing through the larger public stockyards of the country and in the great majority of the slaughtering plants. The duties of these employees, which require them to examine many thousands of animals every day for evidence of disease, give them opportunity for detecting the occurrence of any unusual disease that might have developed while the animals have been in transit. This coverage is not complete, since it does not include the smaller yards and the strictly intrastate slaughtering plants; but it is comprehensive enough to give an effective daily check on the health of animals moving in interstate commerce. All employees engaged in this work have been alerted to the possibilities of biological warfare and instructed accordingly.

Immediate Investigation of Reported Outbreaks of Disease:
A system has been set up whereby state and Federal veterinarians investigate immediately each reported case of unusual disease. Such investigations are made on the premises where the disease is found. To aid in this effort, the Bureau has given special training to several groups of veterinarians strategically located in the country, and has provided them with kits of supplies and materials needed for the differential diagnosis of vesicular diseases. These men are on call at all hours. Their home addresses and telephone numbers are kept current in Bureau and state offices.

In each case of a suspected foreign disease unfamiliar to the field investigators, the Bureau Office in Washington is notified immediately by telephone or telegraph. The Bureau dispatches to the premises experts from its own staff or collaborators who have agreed to serve in an emergency, so that the disease may be identified without delay.

Arrangements have been made with foreign laboratories for sending samples by courier to check any diagnosis that may be questionable.

Arrangements also have been made with the Public Health Service to exchange significant information that might be relative to BW against man or animals.

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Control and Eradication Measures: Arrangements have been worked out by state and Federal authorities for immediate action to control and eradicate any outbreak of foreign animal disease. These arrangements include assumption by the state of responsibility for local quarantines and enforcement of condemnations. The Federal Government assumes responsibility for enforcement of interstate quarantines and cooperates with states in carrying out eradication measures. Each bureau and state office has current lists of the locations where all necessary materials, supplies, and equipment can be obtained promptly for eradication procedures. This is done in lieu of stock-piling, which would be costly and wasteful. Expenses—including indemnification of owners—are shared equally by the Federal Government and the states. The annual Appropriation Act provides emergency funds to the Secretary of Agriculture (available only after an outbreak has occurred), and most of the states have some similar provision for funds—at least enough to get the operation started.

In the case of foreign diseases, plans contemplate: The imposition of quarantines to isolate centers of infection; the slaughter and burial of infected and exposed herds; fair indemnification to owners; thorough clean-up and disinfection of premises; and the use of test animals to determine effectiveness of the work done. These measures require prompt and decisive action at each stage.

In view of the nature of the foreign diseases, complete eradication is the cheapest and most effective action that can be taken under normal conditions. However, under conditions of biological warfare, it may be possible that the spread of the disease will be too rapid and far-reaching to permit complete eradication. In that event, it would be necessary to resort to slower and more costly methods of isolation and vaccination and some orderly method of handling exposed and recovered animals.

Umble vaccines are not available for any of the foreign diseases, and there are no facilities in this country for their preparation. Vaccines that might be imported from foreign countries are generally regarded as unsafe for use and are untested as to potency, particularly with respect to the specific types of variants of virus that may be used in an attack. Vaccine would have to be produced after the outbreak, from the virus recovered from infected animals. In anticipation of such a development, the Federal Civil Defense Administration has made available to the Bureau of Animal Industry approximately \$120,000, enough to stock-pile scarce materials and equipment for production of foot-and-mouth disease vaccines.

Research: Some research is being conducted in several foreign laboratories on foot-and-mouth disease. The Bureau of Animal Industry is maintaining close liaison with the Research and Development Board and

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the Army Chemical Corps to the end that military research on these subjects is made as useful as possible in devising defensive measures. It is desirable and necessary, however, that additional research be done, especially with respect to rinderpest and other foreign diseases.

Coordination with Canada: The Bureau of Animal Industry has maintained over the years an easy and effective coordination with its counterpart agency in Canada. The same situation obtains with respect to emergency planning, on which there has been the closest exchange of information. For example, two Canadian veterinarians were included in the group trained as special diagnosticians by the Bureau this spring. Plans and procedures of the Canadian officials are almost identical with those of the United States.

The Canadian Government reported to the Bureau of Animal Industry on February 25, 1952, the discovery of an outbreak of foot-and-mouth disease on a number of premises near Regina, Saskatchewan. An expert previously had been sent from the Bureau to assist in continuing the diagnosis, as well as to aid in formulating control and eradication measures. The Canadian Government immediately initiated quarantine restrictions, and used the slaughter method to eradicate the outbreak. State and Federal personnel on this side of the border were specially alerted.

2.2 CHEMICAL WARFARE AGAINST ANIMALS.

It is unlikely that chemical warfare will be directed against animals. The results to be obtained from such an attack would be negligible in comparison with the returns from other forms of attack. Nevertheless, some animals will be affected in any attack against man; and local civil defense planning should include measures for humane handling and disposal of such animals.

2.3 RADIOLOGICAL WARFARE AGAINST ANIMALS.

It does not appear at all likely that R/W would be employed against our food animals. Nevertheless, the possibility cannot be entirely dismissed. In the event of an attack by R/W agents, either deliberate, or as the incidental result of an atomic bomb explosion, large numbers of animals in stockyards, as well as the stockyards themselves could be contaminated. There could be difficult problems in the care and disposal of the animals affected, and serious losses could result. These losses could be minimized, however, by proper salvage procedures.

2.3.1 Types of Agents: The types of agent that would be used by

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an enemy in radiological warfare against animals are the same as those described for man.⁴

2.3.2 Types of Enemy Attacks: First it can be said that possible RW attacks would not produce levels of radioactivity resulting in death within 24-48 hours, although it is possible that death might occur 1 to 2 weeks later. This statement might conceivably be subject to modification in an incidental radiological exposure from an atomic-bomb attack, especially in the form of an underwater burst. The deluge of radioactive water might affect many animals in certain localities. An underwater burst is not apt to be considered a profitable military investment in most places, but it might be attempted near large, coastal cities. Since the major concentrations of animals are near inland cities, underwater bursts are not likely to be significant in causing animal destruction.

In general, the levels of exposure in RW are not likely to be high. Nor would the animals exposed to RW necessarily be rendered unfit for human consumption because of radiation effects. However, special problems would be involved, principally: monitoring; the establishment of safety standards relative to the use of the contaminated animals, and to the protection of those processing them; decontamination possibilities; and metabolic considerations.

2.3.3 Estimate of Enemy Capabilities: The discussion of enemy capabilities for waging RW against man⁵ is generally applicable to the same type of warfare against animals.

2.3.4 Estimate of Defensive Capabilities: In an RW attack upon animals, precise local conditions would vary and would call for various specific measures, which cannot be described in detail here.

Early decontamination would be important and helpful even if not completely effective. Simple hosing down and the use of dip methods would carry off excessive and dangerous amounts of radioactive materials and would make slaughtering possible either at once or after a delay to permit further lessening of radioactivity. There are no precise data on this possibility, but it appears a reasonable expectation.

In the event of exceedingly heavy exposures early slaughter might be considered in some instances. Such slaughter should anticipate serious radiation illness and should be carried out no later than a week to 10 days

⁴ See Section 1.3.1 (Man) "Types of Agent".

⁵ See Section 1.3.3 (Man) "Estimate of Enemy Capabilities".

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after exposure. Monitoring would indicate the basis for such consideration as well as the degree of special protection or care requisite for slaughterhouse employees. It would also provide a clue to the practicability of slaughtering for human consumption, by giving a measure of the expense, trouble and danger involved in relation to the value of the animal products.

Much laboratory research has been done on the metabolism of radioactive isotopes. In spite of the resulting body of information, however, the exact nature of problems resulting from gross contamination with such isotopes are unknown. For that reason, serious consideration should be given to experimental tests on animals, large and small, under conditions simulating those that would probably follow an RW attack. The practical radiological and safety problems involved in utilizing contaminated animals for food could then be determined.

Inspectors (and plant operators where there are no inspectors) should be informed of the general effects of RW on animals, and of the methods by which wholesome meat can be safely salvaged from such animals. The principal problems relate to the safety of stockyard and slaughterhouse workers. This is being done by the Meat Inspection Service of the Bureau of Animal Industry, which covers 80 per cent of the commercial slaughter of food animals. Local civil defense authorities should provide similar information and instructions for slaughtering plants not subject to Federal inspection. They should also provide the necessary monitoring service. The Bureau of Animal Industry could collaborate on this matter.

2.4 CONCLUSIONS AND RECOMMENDATIONS:

Conclusions:

Of the three types of agents BW agents present the greatest potential threat to animals in this country, because animals and fowl are highly susceptible to a number of such agents and are vulnerable to overt or covert attack. It is quite likely that epizootics would result, if appropriate diseases were to be introduced by a determined enemy.

The majority of agents that might be used are foreign to the United States. Readiness for eradication or control of diseases introduced into this country requires not only the collection of information from foreign sources, but also research directed toward the perfection of diagnostic procedures, the development and testing of vaccines; and the testing of the control of foreign diseases under conditions existing in this country.

Animals probably would not be attacked by CW or RW agents except as an incidental result of attack on man, and in these circumstances

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most animals contaminated by radioactive materials probably could be salvaged for human consumption.

The division of authority and responsibility between the Federal Civil Defense Administration and the Department of Agriculture for devising protective measures against attack on animals is not clearly delineated. Determination that a particular outbreak is the result of biological warfare would be difficult to establish at best because of the clandestine nature of the attack, but the Department of Agriculture must be prepared to take countermeasures under any circumstances.

Recommendations:

- (1) *That every effort be made to obtain support for the establishment of a research laboratory for the study of animal diseases foreign to the United States of America as authorized by P.L. 496, 80th Congress—2nd Session.*
- (2) *That research presently underway on domestic diseases of animals be maintained and expanded, especially to obtain information on methods for more rapid and accurate diagnosis, on the development of biologics effective in treating exposed animals; and on the development of vaccines that will produce long-lasting immunity.*
- (3) *That the program for reporting diseases of domestic animals be expanded and strengthened.*
- (4) *That the Department of Agriculture in collaboration with other appropriate agencies, study what are likely to be the most fruitful avenues and methods of BW attack on the animals of this country and devise necessary countermeasures. Attack by balloon carriers and countermeasures would be included in such studies.^a*
- (5) *That the Department of Agriculture obtain, as soon as possible, information available in foreign countries on animal diseases not present in this country but which might be used in BW against the United States.*
- (6) *That efforts of the Department of Agriculture to increase the protection of veterinary biologics against sabotage be supported.*

^a See Supplement to this Report.

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- (7) That appropriate measures be taken to effect coordination between the United States and Mexico on defense of animals against biological warfare in a manner similar to the established with Canada.
- (8) That local civil defense units in probable target areas have plans for handling and disposal of animals that may be affected by chemical and biological warfare. Local veterinary groups could do this.
- (9) That the Department of Agriculture, in collaboration with the Atomic Energy Commission, undertake research on the proper methods of salvaging, for human consumption, animals contaminated with radioactive materials; that the Department of Agriculture develop with the Federal Civil Defense Administration and local civil defense organizations recommendations for the safe handling and salvage of food animals contaminated with radioactive materials. Local execution of such recommendations would probably be supervised by local veterinary groups in collaboration with civil defense officials and plans for such action should be prepared immediately.
- (10) That the Federal Civil Defense Administration and the Department of Agriculture collaborate in planning the Federal operational activities necessary to minimize the effects of outbreaks of diseases of animals caused by enemy action.
- (11) That the Federal Civil Defense Administration delegate to the Department of Agriculture responsibility for carrying out such Federal operational activities and retain the responsibility for coordinating the civil defense efforts of the Department of Agriculture with those of other agencies.¹

¹ This does not mean that the Department of Agriculture would assume the functions of state or other agricultural organizations, nor the Federal Bureau of Investigation's responsibility for internal security.

3. CROPS AND FORESTS

3.1 BIOLOGICAL WARFARE AGAINST CROPS.

Of the types of attack possible against plants, biological warfare presents the greatest danger, because it is quite probable that epiphytotics of damaging proportions could be established by a determined attacker.

3.1.1 Types of Agents: Diseases or insects are available that could be used to reduce our supplies of such critical crops as corn, wheat, oats, cotton, potatoes, sugar crops, forage crops, flax, and citrus. A few examples of possible average annual loss in yield from diseases may be cited as follows: spring wheat from stem rust, 10 per cent; potatoes from golden nematode, 10 to 30 per cent; citrus from tristeza, possible total destruction of all existing orange groves; cotton from virus diseases, 5 to 10 per cent; corn from rust, less than 5 per cent; sugar cane from smut, 10 to 20 per cent; sugar beet from yellow wilt, 10 to 50 per cent. Immediate effective control measures for these diseases are generally non-existent at the present time.

A large number of chemical compounds are known to exercise a deleterious effect on plants by altering their metabolism. Some of these compounds are highly specific in their action, while others affect a wide variety of plants. At the present time, plant-growth regulators do not appear to be suitable for large-scale attacks against our crops for the following reasons:

(1) Such large quantities of these compounds are needed for optimum effectiveness that very serious logistic problems would arise if any attempt were made to use them strategically against our food or forest crops. However, technical advances may change this outlook in the future.

(2) Only plants in contact with the poisons are affected. Pathological conditions produced in plants by these agents are not transmitted to other plants.

3.1.2 Types of Attack: Biological agents probably lend themselves most readily to covert warfare, but they could be employed overtly by balloons¹ or by more conventional means of delivery. Clandestine attack

¹ See Supplement to this Report.

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on our crops would seem to be well suited to the current program of psychological and economic harassment of this country without formal declaration of war. Only those agents would be selected that could be expected to persist, spread, and cause economic loss under our climatic conditions. In most cases, very little loss would be expected the season the disease or pest was introduced, but a steady build-up could be expected to take place for several years after the introduction.

3.1.3 Estimate of Enemy Capabilities: Enemy capabilities for waging biological warfare against crops and forests are similar to those for directing such warfare against animals. As in the case of animals, the agents for use against crops can be prepared and delivered with relatively little hazard to operating personnel.

There is a possibility that plant-growth regulators could be used against essential plants grown in relatively limited quantities in concentrated areas. It may be, also, that other countries have developed more effective plant poisons than has the United States, but such a possibility is unlikely.

3.1.4 Estimate of Defensive Capabilities: In keeping with the principle of maximum utilization of existing governmental resources, the Federal Civil Defense Administration has requested the Department of Agriculture to use its facilities for the protection of crops and forests against biological, chemical and radiological warfare agents. In some instances, however, the division of responsibility for operational activities and research activities between the Federal Civil Defense Administration and the Department of Agriculture is unclear.

No additional funds were made available for this work in the fiscal year 1952, and the special civil defense work has been assigned as additional duty to those employees in the Department of Agriculture who are normally engaged in the work of protecting crops and forests.

Breeding for resistance to known domestic and foreign pathogens offers the best long-range means of controlling many plant diseases. The Department of Agriculture and many universities have projects underway to develop varieties resistant to virulent pathogens of small grains. These should be expanded to include other important crops previously mentioned.

Early detection and identification of plant diseases, insects and other pests is, and must be, an essential phase of our plant protection program. Immediate action to spray or dust local outbreaks could, in many cases, eliminate the danger or reduce the amount of initial disease inoculum or insect infestation, thus delaying and minimizing spread. Such action

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applied to field-grown corn throughout the growing season, seriously affected the plants; and a dose of 250-r per day reduced the yield. Exposures of this order of magnitude, or greater, are required to affect potatoes, wheat, barley, strawberries, and tobacco. The substantial resistance of these plants to radiation and the difficulties of application make it unlikely that these crops would be subjected to radiological warfare. The concentrations necessary to kill or seriously impair plants would require the distribution over vast areas of amounts of isotopes in quantities far in excess of those necessary to eliminate all animal life in the affected areas.

The genetic effects of radiation upon plants can probably be discounted, since even under very considerable doses of radiation only a small fraction of plants will produce mutants; and in the case of food crops, radiologically resistant strains are available.

3.4 CONCLUSIONS AND RECOMMENDATIONS.

Conclusions:

Of the three types of agents, biological warfare agents present the greatest potential threat to the crops of this country; because, if these were introduced at the proper time and place either by covert or overt means, epiphytotic would probably result. The use of plant-growth regulators against major food crops in the United States is unlikely because of serious logistic problems. Radiological warfare agents are a relatively minor threat to crops. Balloon-delivery of fire bombs is a serious threat to forests and grain fields at harvest time.

Division of authority and responsibility for operational activities at the Federal level remains somewhat unclear.

Recommendations:

- (1) That the following activities now being carried on by the Department of Agriculture be expanded:
 - (a) The program of breeding crop strains resistant to known domestic and foreign plant pathogens.
 - (b) The organization for, and methods of detecting, reporting and identifying and controlling outbreaks of plant diseases, insects and other pests.

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might be particularly important in case of a new rust race. Prompt initiation of local quarantine, also, can be an effective control measure in certain types of outbreaks.

The use of plant-growth regulators can easily be detected by trained plant physiologists and pathologists, and such persons should be included in any team sent to investigate a suspicious outbreak of plant disease.

The Department of Agriculture Plant Disease Survey and the Cooperative Economic Insect Survey, working with state agencies, provide the following services:

(1) Early detection and identification of plant diseases, insects and pests, with immediate alerting of county agents, state control agencies and interested individuals.

(2) Collection and dissemination of current information on developments in research and equipment useful in the control and eradication of plant diseases, insects and other pests.

(3) Distribution of information concerning manufacturing capacity and expansibility, supply reserves, and so on, and assistance to manufacturers, distributors, control officials, farmers and others, on the distribution and timely use of fungicidal and insecticidal supplies.

These services have been expanded modestly to meet the emergency threat but should be expanded further. The Federal Civil Defense Administration is requesting funds for such expansion.

3.2 CHEMICAL WARFARE AGAINST CROPS.

There seems to be no problem of chemical warfare against plants. Any damage to plants from CW agents would be incidental to attack on man or animals and would be too slight to affect crop production materially.

3.3 RADIOLOGICAL WARFARE AGAINST CROPS.

There appears to be little likelihood of radiological warfare against plants. At the Brookhaven National Laboratory it has been found that 700-r² per day were necessary to kill corn seedlings, and that an even higher dosage is necessary to kill mature plants. A dose of 400-r per day,

² r = roentgen—a measure of a quantity of radiation. 400-r total body radiation usually results in death in man.

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- (c) *The collection and dissemination of current information on research, materials and equipment useful in plant disease and pest control.*
- (d) *The inspection at ports of entry to make as effective as possible the prevention of accidental or intentional introduction of plant diseases, insects, and other pests.*
- (2) *That the Department of Agriculture, in collaboration with other appropriate agencies, study the most probable avenues and methods of BW attack on the crops and forests of this country and devise necessary countermeasures. Studies of timing and location of attack by balloon carriers and countermeasures should be included.*
- (3) *That the Federal Civil Defense Administration and the Department of Agriculture³ collaborate in planning the Federal operational activities necessary to minimizing the effects of enemy attacks upon crops by diseases, insects, and other pests; that the Federal Civil Defense Administration and the Department of the Interior⁴ collaborate in planning the Federal operational activities necessary to minimize the effects of outbreaks of forest fires.*
- (4) *That the Federal Civil Defense Administration delegate to the Department of Agriculture responsibility for carrying out Federal operational responsibilities necessary to minimize the effects of enemy attacks upon crops and to the Department of Interior similar responsibility with respect to the outbreak of forest fires.*
- (5) *That the Federal Civil Defense Administration retain responsibility for coordinating the civil defense efforts of the Department of Agriculture and the Department of the Interior with those of other government agencies.*

³ This does not mean that the U. S. Department of Agriculture would assume the functions of state or other agricultural organizations, nor the Federal Bureau of Investigation's responsibility for internal security.

⁴ For the National Park Service.

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