

HEALTH ASPECTS  
OF  
CHEMICAL AND BIOLOGICAL  
WEAPONS

Report of a WHO Group of Consultants



WORLD HEALTH ORGANIZATION

GENEVA

1970

*This report was completed on 21 November 1969 and submitted on 28 November 1969 to the Secretary-General of the United Nations.*

© World Health Organization 1970

Publications of the World Health Organization enjoy copyright protection in accordance with the provisions of Protocol 2 of the Universal Copyright Convention. Nevertheless governmental agencies or learned and professional societies may reproduce data or excerpts or illustrations from them without requesting an authorization from the World Health Organization.

For rights of reproduction or translation of WHO publications *in toto*, application should be made to the Division of Editorial and Reference Services, World Health Organization, Geneva, Switzerland. The World Health Organization welcomes such applications.

This report contains the collective views of an international group of experts and does not necessarily represent the decisions or the stated policy of the World Health Organization.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Director-General of the World Health Organization concerning the legal status of any country of territory or of its authorities, or concerning the delimitation of its frontiers.

The mention of specific companies or of certain manufacturer's products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature which are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

PRINTED IN SWITZERLAND

## CONTENTS

	Page
1. INTRODUCTION . . . . .	9
2. COMPARISON OF THE WHO AND UNITED NATIONS REPORTS AND THEIR CONCLUSIONS . . . . .	10
3. AIM AND SCOPE OF THE WHO REPORT . . . . .	11
4. WORKING DEFINITIONS OF CHEMICAL AND BIOLOGICAL WEAPONS FOR THE PURPOSES OF THIS REPORT . . . . .	12
5. SELECTION OF CHEMICAL AND BIOLOGICAL AGENTS AS MODELS FOR QUALITATIVE AND QUANTITATIVE ASSESSMENTS . . . . .	12
6. BASES OF THE ESTIMATES OF CASUALTIES . . . . .	13
7. LONG-TERM EFFECTS . . . . .	14
8. SUMMARY . . . . .	17
9. IMPLICATIONS FOR THE WORLD HEALTH ORGANIZATION AND ITS MEMBER STATES . . . . .	19

### ANNEX 1. CHEMICAL AGENTS

Classification and definitions . . . . .	23
A. LETHAL AGENTS . . . . .	25
Historical introduction . . . . .	25
Specification of toxicity of chemical agents . . . . .	27
1. Lung irritants . . . . .	27
(i) Phosgene . . . . .	27
2. Blood gases . . . . .	29
(i) Hydrogen cyanide . . . . .	29
(ii) Cyanogen chloride . . . . .	30
3. Vesicants . . . . .	31
(i) Mustard gas . . . . .	32
4. Nerve gases . . . . .	35
(i) Sarin . . . . .	36
(ii) Agent VX . . . . .	39
5. Other lethal chemical warfare agents . . . . .	41
(i) Botulinal toxins . . . . .	41
B. INCAPACITATING AGENTS . . . . .	44
Introduction . . . . .	44
1. Bacterial enterotoxins and related substances . . . . .	44
(i) Staphylococcal enterotoxins . . . . .	44
2. Psychochemicals . . . . .	46
(i) LSD . . . . .	47
(ii) Agent BZ . . . . .	49
C. HARASSING AGENTS (SHORT-TERM INCAPACITANTS) . . . . .	51
Introduction . . . . .	51
(i) CN . . . . .	53
(ii) CS . . . . .	53
(iii) DM . . . . .	55
D. ANTI-PLANT AGENTS . . . . .	55

## ANNEX 2. BIOLOGICAL AGENTS

INTRODUCTION . . . . .	60		
A. VIRAL INFECTIONS . . . . .	61		
1. Arthropod-borne (arboviruses) . . . . .	61	(vi) Chikungunya . . . . .	66
(i) Yellow fever . . . . .	62	(vii) O'nyong-nyong . . . . .	67
(ii) Tick-borne encephalitis . . . . .	63	(viii) Rift Valley fever . . . . .	67
(iii) Japanese encephalitis . . . . .	64	2. Other viral infections . . . . .	68
(iv) Dengue . . . . .	65	(i) Influenza . . . . .	68
(v) Venezuelan equine encephalitis . . . . .	66	(ii) Smallpox . . . . .	69
B. RICKETTSIAL INFECTIONS . . . . .	70		
1. Typhus, epidemic . . . . .	70	3. Q fever . . . . .	72
2. Rocky Mountain spotted fever . . . . .	71		
C. BACTERIAL INFECTIONS . . . . .	73		
1. Plague . . . . .	73	4. Brucellosis . . . . .	76
2. Anthrax . . . . .	74	5. Typhoid fever . . . . .	77
3. Tularaemia . . . . .	75		
D. FUNGAL INFECTIONS . . . . .	78		
1. Coccidioidomycosis . . . . .	78		
E. THE PREDICTABILITY OF EPIDEMICS . . . . .	79		
1. Epidemiological considerations . . . . .	79	3. Danger of epidemic warfare as a tactical weapon . . . . .	81
2. Mathematical considerations . . . . .	80		

## ANNEX 3. BASES OF QUANTITATIVE ESTIMATES

A. HYPOTHESES CONCERNING DELIVERY, DISPERSION AND CONCENTRATION OF AGENTS . . . . .	84		
1. Delivery . . . . .	84	7. Influence of the volatility of the agent . . . . .	91
2. Specification of dosage . . . . .	84	8. Possibility of more efficient means of attack . . . . .	91
3. Specification of toxicity and infectivity . . . . .	85	9. Conclusions on the feasibility of an attack with chemical weapons on urban areas . . . . .	92
4. Local meteorological factors . . . . .	87	10. Implications for protection . . . . .	93
5. Influence of local meteorological factors on the effectiveness of an attack with chemical weapons . . . . .	88		
6. Fall-out as a factor influencing the incidence of attack . . . . .	89		
B. HYPOTHESES CONCERNING BIOLOGICAL AGENTS . . . . .	93		
C. ESTIMATES OF NUMBERS OF CASUALTIES . . . . .	95		
D. POPULATION MODELS . . . . .	97		

	Page
<b>ANNEX 4. MEDICAL AND PUBLIC HEALTH EFFECTS OF ATTACK WITH CHEMICAL OR BIOLOGICAL WEAPONS</b>	
INTRODUCTION . . . . .	101
GENERAL PRINCIPLES . . . . .	102
1. Problems in preparing for defence against an attack . . . . .	102
2. Immediate problems in the event of an attack . . . . .	103
3. Problems after the attack . . . . .	103
EXAMPLES BASED ON HYPOTHETICAL SITUATIONS. . . . .	103
Assumptions on availability of health resources . . . . .	103
A. TULARAEMIA. . . . .	105
B. PNEUMONIC PLAGUE . . . . .	107
C. NERVE GAS—VX . . . . .	110
<b>ANNEX 5. SABOTAGE OF WATER SUPPLIES</b>	
INTRODUCTION . . . . .	113
CONTAMINATION BY THE TYPHOID BACILLUS . . . . .	115
CONTAMINATION BY BOTULINAL TOXIN, TYPE A . . . . .	116
CONTAMINATION WITH LSD . . . . .	117
PREVENTIVE MEASURES . . . . .	119
<b>ANNEX 6. PSYCHOSOCIAL CONSEQUENCES OF CHEMICAL AND BIOLOGICAL WEAPONS</b>	
INTRODUCTION . . . . .	121
POSSIBLE PSYCHOSOCIAL CONSEQUENCES OF THE THREAT OF CHEMICAL AND BIOLOGICAL WARFARE. . . . .	122
POSSIBLE PSYCHOSOCIAL CONSEQUENCES OF THE USE OF CHEMICAL AND BIOLOGICAL WEAPONS . . . . .	126
CONCLUSION . . . . .	127
<b>ANNEX 7. RESOLUTION 2454 A (XXIII) OF THE GENERAL ASSEMBLY OF THE UNITED NATIONS</b>	
Question of General and Complete Disarmament . . . . .	129
<b>ANNEX 8. RESOLUTION WHA 20.54 OF THE TWENTIETH WORLD HEALTH ASSEMBLY</b>	
Consideration of Resolution 2162 (XXI) of the General Assembly of the United Nations : Question of General and Complete Disarmament . . . . .	131
<b>ANNEX 9. RESOLUTION WHA 22.58 OF THE TWENTY-SECOND WORLD HEALTH ASSEMBLY</b>	
Question of General and Complete Disarmament : Chemical and Bacteriological (Biological) Weapons and the Consequences of their Possible Use. . . . .	132

## CONSULTANTS

Professor O. V. BAROYAN, Director, Gamaleja Institute of Epidemiology and Microbiology, Academy of Medical Sciences of the USSR, Moscow, USSR

Dr D. BLASKOVIČ, Director, Institute of Virology, Czechoslovak Academy of Sciences, Bratislava, Czechoslovakia

Dr K. EVANG, Director-General, The Health Services of Norway, Oslo, Norway

Professor R. B. FISHER, Department of Biochemistry, University of Edinburgh, Scotland

Professor L. HUISMAN, Department of Civil Engineering, Technological University, Delft, Netherlands

Dr J. H. HUMPHREY, Head, Division of Immunology, National Institute for Medical Research, London, England

Professor N. K. JERNE, Director, Paul Ehrlich Institute, Frankfurt am Main, Federal Republic of Germany

Professor J. LEDERBERG, Department of Genetics, Stanford University School of Medicine, Stanford, Cal., USA

Professor A. M. LWOFF, Director, Institute of Scientific Research on Cancer, Villejuif, France

Professor O. MAALOE, Institute of Microbiology, University of Copenhagen, Denmark

Professor I. MALEK, Institute of Microbiology, Czechoslovak Academy of Sciences, Prague, Czechoslovakia

Professor M. MESELSON, The Biological Laboratories, Harvard University, Cambridge, Mass., USA

Dr F. PASQUILL, Meteorological Office, Bracknell, Berks., England

Mr J. P. PERRY ROBINSON, Stockholm International Peace Research Institute (SIPRI), Sweden

Professor M. P. SCHUTZENBERGER, Faculty of Science, University of Paris, France

Professor V. W. SIDEL, Department of Community Health, Albert Einstein College of Medicine; Chief, Division of Social Medicine, Montefiore Hospital and Medical Center, New York, USA

Dr Berhane TEOUME-LESSANE, Co-Director, Imperial Central Laboratory and Research Institute, Addis Ababa, Ethiopia

Mr F. W. J. VAN HAAREN, Head, Laboratories of the Municipal Water Works, Amsterdam, Netherlands

*Secretary to the Group :*

Dr M. KAPLAN, Special Assistant for Science, Office of the Director-General, WHO, Geneva, Switzerland