Chemical and Biological Warfare
Chemical and Biological Warfare
A COMPREHENSIVE SURVEY FOR THE CONCERNED CITIZEN

ERIC CRODDY
WITH CLARISA PEREZ-ARMENDARIZ AND JOHN HART

Copernicus Books
An Imprint of Springer-Verlag
## Contents in Brief

**PART ONE: GAS, BUGS, AND COMMON SENSE**

- Chapter 1: The Fog of War .......................................................... 1
- Chapter 2: Who Has These Weapons? .......................................... 3
- Chapter 3: Threats and Responses .............................................. 19

**PART TWO: CHEMICAL AGENTS**

- Chapter 4: Basic Concepts ........................................................... 87
- Chapter 5: Chemical Warfare: A Brief History ............................... 127
- Chapter 6: Control and Disarmament .......................................... 169

**PART THREE: BIOLOGICAL AGENTS**

- Chapter 7: Basic Concepts ............................................................ 193
- Chapter 8: Biological Warfare: A Brief History ............................. 219
- Chapter 9: Control and Disarmament .......................................... 237
- Chapter 10: Vaccination and Biological Warfare ............................ 249
Contents

PREFACE XVII
ACKNOWLEDGMENTS XIX
INTRODUCTION XXI

How This Book Is Organized XXII

PART ONE: GAS, BUGS, AND COMMON SENSE 1

Chapter 1: The Fog of War 3

GAS AND BUGS 5
CBW, Briefly Defined 6

THE UTILITY OF CBW AGENTS 7
Making the Enemy “Suit Up” 7
Leaving a Large Footprint 8
Implying a Threat 9

ACQUISITION 9
Obtaining CW Precursors 10
The Development of BW Programs 10
Dual-Use Technologies in BW 12
Production 12
CW Agent Production 12
BW Agent Production 13

WEAPONIZATION 14
CW Weapon Design 14
Weaponizing BW Agents 16
Chapter 2: Who Has These Weapons?

THE SUPERPOWER AND FORMER SUPERPOWER
The United States
- Chemical Weapons
- CW in World War II
- CW During the Cold War
- Current Status of US Chemical Weapons
- Biological Weapons
- The Post-World War II Era and the Korean War
Russia and the Former Soviet Union
- Chemical Weapons
- The Russian Federation in the 1990s
- Biological Weapons

THE MIDDLE EAST
Iraq
- Chemical Weapons
- Iraqi VX
- Biological Weapons
Iran
- Chemical Weapons
- Biological Weapons
Syria
- Chemical Weapons
- Biological Weapons
Egypt
- Chemical Weapons
- Biological Weapons
Libya
- Chemical Weapons
- Operation at Tarhunah
- Biological Weapons
Israel
- Chemical Weapons
Biological Weapons

**EAST ASIA**
North Korea
- Chemical Weapons
- Suspected CW Arsenal
- Biological Weapons
South Korea
China (PRC)
- Chemical Weapons
  - Biological Weapons
Taiwan

**OTHER PLAYERS**
South Africa
- Chemical Weapons
  - Biological Weapons
Cuba

**SUB-STATE ACTORS**

---

**Chapter 3: Threats and Responses**

**A NEW KIND OF WARFARE**
- The First World Trade Center Bombing
- Aum Shinrikyo
- Taking the Toll

**MEDICAL THREATS AND RESPONSES**

Anthrax
- The Disease
  - Anthrax as a Weapon
  - Treatment and Vaccination
Smallpox
  - The Disease
  - Smallpox as a Weapon
  - Vaccination

**CIVIL DEFENSE THREATS AND RESPONSES**

The Chemical Industry
  - Bhopal
Densely Populated Spaces
Water Supplies
Crop Dusters
PART TWO: CHEMICAL AGENTS

Chapter 4: Basic Concepts

WHAT CHEMICAL WEAPONS ARE NOT

WHAT CHEMICAL WEAPONS ARE

Properties
Delivery Systems

BASIC CLASSES OF CW AGENTS

Choking Gases (Lung Irritants)
- Chlorine
- Phosgene
- Diphosgene
- Chloropicrin (or Chloropicrin)
- Ethylidichlorarsine
- Perfluorobutylene (PFB)

Blister Agents (Vesicants)
- Mustard (Sulfur)
- Nitrogen Mustard
- Lewisite
- Phosgene Oxime ("Nettle Gas")
- Phenylidichlorarsine (PD)

Blood Agents
- Hydrogen Cyanide: Instrument of the Shoah
- Cyanogen Chloride
- Arsin (Arseniuretted Hydrogen)
- Carbon Monoxide
- Hydrogen Sulfide ("Sour Gas")

Nerve Agents (Toxic Organophosphates)
- Nerve Agent Proliferation
- Dynamics of Nerve Agent Poisoning

Incapacitants: Psychoactive Chemicals in War
- Belladonna, or Glycolate Alkaloids
- 3-Quinuclidinyl Benzilate (BZ)
- Ergot and Lysergic Acid Diethylamide (LSD)
Chapter 6: Control and Disarmament

HISTORICAL PRELUDES
- Early Twentieth Century Negotiations
  - The Hague Conferences
  - The Washington Arms Conference
  - The 1925 Geneva Protocol

THE CHEMICAL WEAPONS CONVENTION (CWC)
- Controlling Agents and Precursors
- Scheduling Agents and Precursors
  - Schedule 1 Agents and Precursors
  - Schedule 2 Agents and Precursors
  - Schedule 3 Agents and Precursors
- Declarations and the CWC
  - Export Controls
  - The Australia Group
- Verification of Compliance

MONITORING AGENTS AND THEIR PRECURSORS
- Monitoring of CW Agents (Schedule 1)
- Monitoring of CW Precursors (Schedule 2)
- Monitoring of Commercial Chemicals (Schedule 3)
- Proliferation Signatures
- Challenge Inspections
- Managed Access

DESTRUCTION OF CHEMICAL WEAPONS
- Not in My Backyard
- The Destruction and Conversion of Facilities
- Brain Drain in the Former Soviet Union
### PART THREE: BIOLOGICAL AGENTS

#### Chapter 7: Basic Concepts

193

#### BIOLOGICAL WARFARE AGENTS

196

#### THE NATURE OF INFECTIOUS DISEASE

198
- The Germ Theory of Disease
  198
- The Advent of Modern Microbiology
  199
- The Airborne Origin of Infectious Disease
  200

#### DIFFERENTIATING AMONG PATHOGENS

200
- Bacteria
  200
- The Rickettsiae
  200
- Viruses
  201
- Bioaerosols
  202

#### BIOLOGICAL WARFARE AGENTS

204
- Bacteria
  205
  - Anthrax
  205
  - Plague
  206
  - Tularemia
  207
  - Glanders
  207
  - Q-Fever
  208
  - Cholera
  208
- Viruses
  209
  - Smallpox
  209
  - Hemorrhagic Fever Viruses
  210
  - Venezuelan Equine Encephalitis (VEE)
  211
  - Foot-and-Mouth Disease
  212
- Biological Toxins
  213
  - Mycotoxins
  213
  - Fungi (Molds)
  214
  - Botulinum Toxin
  214
  - Staphylococcal Enterotoxin Type B (SEB)
  215
  - Ricin and Saxitoxin
  216
  - Trichothecene Mycotoxins (T2)
  216
Chapter 8: Biological Warfare: A Brief History

BIOLOGICAL WEAPONS IN ANCIENT TIMES
Biological Warfare in the New World

BIOLOGICAL WARFARE IN MODERN TIMES
World War I
The Geneva Protocol of 1925
Japanese BW, 1932–1945

THE UNITED STATES BW PROGRAM
Development Phase: 1939–1950
The Post-World War II Era and the Korean War

SOVIET BIOLOGICAL WEAPONS: 1919–1989
The Biopreparat Complex
BW in Russia Today

Chapter 9: Control and Disarmament

HISTORY
Summary of the BTWC
The Review Conferences
1980
1986
1991
1997

THE BTWC TODAY

THE FUTURE OF THE BTWC
# Chapter 10: Vaccination and Biological Warfare

## DISEASE AS DETERRENCE
- Smallpox, Variolation, and the First Vaccines
  - *Jenner’s Vaccinia*
- Typhus and DDT

## MODERN MILITARY VACCINATIONS
- Typhoid and the Boer War (1899–1902)
- Yellow Fever as a BW Threat
- Japanese B Encephalitis and the War in the Pacific
- Botulinum and D-Day
- Plague and the Vietnam War (1965–1975)
- Botulinum Toxoid and the Gulf War (1991)
- Vaccinating for Anthrax in the Twenty-First Century
  - *Historical Development*
  - *The Current Controversy*

## NOTES

## SELECT BIBLIOGRAPHY

## INDEX
As these lines are being written, firemen, police officers, and a host of other rescue workers are still trying to save victims of the terrorist attacks on the World Trade Center and the Pentagon. Even without precise counts of the dead and wounded in Pennsylvania, Virginia, and New York, we can already conclude that this attack was a signal event of mass destruction, with the outcome certain to make it the deadliest single terrorist act ever committed against United States citizens. The number who died in the attacks and the 100-minute aftermath will almost certainly exceed the number of American armed forces killed at Pearl Harbor, or on D-Day. But these victims of terror were, by and large, civilians, people going about their business. And the instruments of their death, the murder weapons, were not, until yesterday, considered weapons at all.

It is always hard, but especially under these circumstances, to talk about weaponry, the tools of war and terror. What can these new weapons be compared to? How can they be described? The US Department of Defense categorizes the most deadly kinds of armaments as “weapons of mass destruction,” or WMDs, and defines them as “capable of a high order of destruction . . . of being used in such a manner as to destroy large numbers of people.”* This does not tell us much. How does one define “a high order of destruction” and “large numbers of people”? Timothy McVeigh, who was responsible for bombing the Alfred P. Murrah Federal Building in Oklahoma City in 1995, was indicted on US federal charges for using a WMD, a truckload of improvised explosives. In the blast, 168 people were killed—again overwhelmingly civilians, men, women, and children going about their business.

Was McVeigh charged with using a WMD because 168 is a large enough number? Is this or a number near it the dividing line between an ordinary act of savagery and one in which we call the killers’ implements weapons of mass destruction?

destruction? Chemical and biological armaments have the potential to kill huge numbers of people, many times the number killed by McVeigh's bomb. And certainly it seems to make sense that the US Department of Defense categorizes them as WMDs. But is it not true that almost any weapon, even the machetes used in Rwanda in 1994, can be used to perpetrate horrors on an unspeakable scale?

The term “weapons of mass destruction”—probably coined in 1956 by the Soviet Red Army Marshal Georgi Konstantinovich Zhukov (known as “the hero of Stalingrad”)—has, like any defining or categorizing word, its shortcomings. It explains some things, but goes only so far. The arms expert Ken Alibek, whom we shall meet later in this book, suggests that a better name for biological armaments might be “mass casualty weapons,” since their object is to inflict human injury but not to destroy buildings or property. Distinctions like these are grim—but they are also useful. They help us refine and sharpen our sense of things. They help us face up to and describe in words what otherwise may be overwhelming, confusing, frightening. And of course trying to face up to facts and describe events—no matter how horrible they may be—is the first step toward understanding.

My wish is that readers will take up this book in that spirit. Studying weaponry and warfare and disarmament isn't just a challenging and stimulating intellectual discipline for its own sake. The stakes are much too high for that. Its aim instead is to help us understand a long-standing aspect of human behavior, a force in human history, that seems capable of devising new tools of destruction that we may have to face at times and in places where we least expect them—in a pair of towers above a great harbor, in offices at the heart of our vast and powerful military establishment, and in a quiet country field in southwestern Pennsylvania.

Eric Croddy
Monterey, California
October 23, 2001
Acknowledgments

The Monterey Institute, Center for Nonproliferation Studies, would like to thank the Ploughshares Fund for their generous support of this project. Any views expressed herein are solely those of the author, and not necessarily those of the Ploughshares Fund or the Monterey Institute.

I would personally like to thank the following people, all of whom were instrumental in making this book happen. First, I want to thank Jonathan B. Tucker, the director of the Chemical and Biological Weapons Nonproliferation Program at the Monterey Institute, who initiated this project and Clarisa-Perez Armendariz and John Hart who made strategic contributions towards the development of the text. I also wish to thank other colleagues at the Monterey Institute who were always there for me when I needed assistance or scholarly advice: Jason Pate, Diana McCauley, Gavin Cameron, Kathleen Vogel, Gary Ackerman, Kimberly McCloud, Raymond Zilinskas, Amy Sands, Tim McCarthy, Mari Sudo, Dan Pinkston, Amin Tarzi, Michael Barletta, Gaurav Kampani, Sonia Ben Ouaghrham, Fred Wehling, Yuan Jing-Dong, Evan Medeiros, Lisa Burns, Phillip Saunders and Clay Moltz. Dr. Anthony T. Tu has been most helpful, and I am privileged to have his friendship as well as expertise. Martin Hugh-Jones has been most patient with my inane questions from time to time. My good friends and scholars at the National Chengchi University in Taiwan, Yuan I and Arthur S. Ding have taught me a great deal about East Asian proliferation issues, and Jean-Pascal Zanders has been a wealth of wisdom and a dear friend. Thanks also go to my colleagues and Monterey Institute of International Studies graduates Ken Palnau, Anisha Lal, Anjali Bhattacharjee, Matt Osbourne, Tim Ballard, Faith Stackhouse, Garvey McIntosh, and Jason Evans for their invaluable support in developing the book. My dear friend Al J. Venter has made important contributions to my thinking about a number of issues discussed here. Special thanks go to the excellent editorial staff at Copernicus Books for really making it all happen and to Michael Hennelly for his invaluable advice. Our appreciation goes to Pernacca Sudhakaran, Ewen Buchanan, and the excellent staff at the UN photo laboratory for their dedication and generous use of photographs. There are many others who would prefer to remain anonymous, but I want to thank them as well.

A big thank you to my family for their love and support.

Any errors, committed or otherwise, are solely my responsibility.
Introduction

Why study chemical and biological warfare (CBW)? At the very lowest level, the topic lends itself to morbid curiosity. The scale on which “bugs and gas” can be used to kill people, and the way in which they cause death, can make for gruesome reading. Then there is the matter that these weapons are considered, rightly or wrongly, to be abominable, and those who wish to confirm that opinion will find in studying CBW plenty to abhor. Readers in these two categories are likely to be disappointed by what they will find in this book.

Fear is another motive for study. One can hardly read the paper or listen to the news today and not, sooner rather than later, hear reports about the bellicose nations, repressive regimes, and terrorist organizations that have access to, or are working on the development of, these weapons. The mere existence of CBW armaments, we are told, poses a significant threat to the stability of international order. Even if one believes that the nuclear standoff between superpowers—the Balance of Terror that characterized the Cold War—is a thing of the past, we now have a whole new cast of characters to worry about. They are less well understood than our old adversary the Soviet Union, and less predictable. They operate as states (or sometimes “rogue states”), but also in the shadows, in league with networks of terrorists, global criminal enterprises, and splinter groups representing every conceivable type of fanaticism. And they will, it is almost certain, push us into a whole new kind of decades-long war. For readers arriving with this point of view, I hope this book will serve as a kind of corrective.

It is not my belief that CBW armaments are benign, or that states and substate organizations are not wishing for or even planning chemical or biological attacks against the United States and the rest of the industrialized world. I am not someone who places great faith in the good will and sober judgment of, say, Saddam Hussein. In fact, if I were a betting man, I would put my money on the likelihood that we will see chemical or biological weapons attacks in the not-too-distant future. But where this book perhaps differs from some more popular discussions of the topic is in its argument, in its underlying theme, that biological and especially chemical attacks of any magnitude are extremely difficult to plan, develop, execute, and fund. Certainly it is true that a fanatical cult...
could release nerve agent on a crowded subway car, as happened in Tokyo in March 1995. And the ultimate splinter group, a single deranged individual, may be perfectly capable of killing, injuring, or incapacitating large numbers of individuals in any number of ways chemical or biological. If you add to these all the belligerent major powers, rogue states, and oppressive regimes worldwide (and factor in their client terrorist organizations as well), you can imagine no end of mischief—gas attacks, reservoir poisonings, anthrax outbreaks, and so forth. But what we have to do is dwell less on nightmare scenarios and try to learn—as calmly and clearly as possible—what CBW agents are, how they work, who has used them in the past, and what is being done to limit their proliferation. Fear may be a good motivator, but it is not, as far as I can tell, an aid to understanding.

_How This Book Is Organized_

This book is divided into three major parts. In Part I, “Gas, Bugs, and Common Sense,” there is a brief introduction to and definition of CBW (Chapter 1), including descriptions of why and how nation-states and “sub-states” (for example, terrorist organizations) develop chemical and biological weapons. Chapter 2 then lists, in a fairly straightforward manner, the nations that have CBW capabilities, along with brief descriptions of the particular agents they possess. In Chapter 3, we take a look at some of the threats we’re likely and unlikely to face.

Part II is focused on chemical weapons. In Chapter 4, there are rather extensive descriptions and discussions of more than fifty of the best-known CW agents. Chapter 5 is a history of chemical warfare from ancient times to the present. And Chapter 6 discusses in detail the workings of the 1992 Chemical Weapons Convention (CWC), by all accounts one of the most effective international treaties written. (But not, as the chapter makes clear, without its limitations.) Included in the chapter is a lengthy discussion of the extremely difficult matter of verification, and the highs and lows of the international community’s relationship with Iraq, an unwilling signer of the accord.

Part III, which more or less mirrors Part II, focuses on biological agents and weapons, with Chapter 7 describing more than forty biological agents in detail. Chapter 8 focuses on BW armaments in history, again covering a broad span. Chapter 9 covers the Biological Weapons and Toxins Convention of 1972 (BWTC), a work of the best intentions but not much good effect. (The success of the CWC and the comparative ineffectiveness of the BWTC are discussed in some detail.) Finally, a whole chapter (Chapter 10) is devoted to the issue of vaccinations and biological warfare.
Chemical and Biological Warfare
A Comprehensive Survey for the Concerned Citizen
Croddy, E.
2002, XXII, 306 p., Hardcover
ISBN: 978-0-387-95076-1