BIOLOGICAL WEAPONS

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Iraq Said to Have Supply Of Biological Weapons

Arsenal Adds to Peril of Forces in Gulf Region

THE WASHINGTON POST

A16 SATURDAY, DECEMBER 29, 1990 ...

U.S. Troops to Get Germ War Vaccines

Sunday Times, 26th February 1995, Page 1.1

Gadaffi lures South Africa's top germ warfare scientists

Dallas, Texas, Monday, March 20, 1995

Fumes kill six, sicken thousands on Tokyo subway

Officials suspect nerve gas attack

A14 TUESDAY, FEBRUARY 28, 1995 THE WASHINGTON POST

Toxic S. African Arms Raise Concern

U.S. Wants Assurance '80s Chemical, Germ Weapons Program Is Dead

Wednesday, April 5, 1995 11 Sections HF

U.S. suspects Iraqis trying to build biological weapons

Dallas, Texas, Wednesday, August 23, 1995 11 Sections

Iraq says it armed missiles with biological weapons

Dallas, Texas, Wednesday, March 29, 1995

Bacteria found at cult site

Japan sect may have plotted germ warfare

INTRODUCTION

Biological weapons are microorganisms or toxins derived from living organisms intentionally used to produce disease or death in humans, animals or plants. Biological and chemical agents are often considered together since both are weapons of mass destruction, delivery systems are frequently similar, movement of the agents from munition to target is generally in aerosol or vapor form and carried or controlled by wind and weather. Many items and procedures of physical defense are identical. Yet biological weapons are entirely different in effects, in medical treatment required and in speed of action. On receiving the Nobel Prize for Chemistry in 1919, Professor Fritz Haber, pioneer of gas warfare, stated "In no future war will the military be able to ignore poison gas. It is a higher form of killing."[1] Chemical warfare is arguably more humane than conventional warfare. Only 2% of US chemical casualties in WWI died as opposed to 25% of conventional casualties.[2] Aldous Huxley in Brave New World (1932) wrote "The noise of fourteen thousand aeroplanes advancing in open order. But in the Kurfurstendamm and the Eighth Arrondissement, the explosion of anthrax bombs is hardly louder than the popping of a paper bag." Estimates of comparative costs (dollars/Km^2 attacked/damaged) are striking: conventional high explosive weapons $2000, nuclear weapons $800, a chemical weapon (Soman. GD) $600, biological weapons $1.[3] Chemical and potentially biological agents have become the nuclear weapons of third world rogue nations and terrorist groups, being cheap, easy to conceal and easy to use.

HISTORICAL

Warring factions have used, threatened to use or accused their enemies of using various forms of biological weapons (BW) throughout recorded history. Poupard and Miller, in reviewing the subject, have divided the chronology into six periods.[4] I will use their first two, combine the third and fourth (1925-1972) and the fifth and sixth (1972-present).

I. <u>The Era of Corpses, Pollution, Catapults:</u> 300 BC to 1763 AD. As early as 300 BC the Greeks polluted the wells of their enemies with corpses of animals. In 1155 at a battle on Tortona, Italy, Barbarossa broadened the scope of BW, using the bodies of dead soldiers as well as animals to pollute wells. The use of catapults in medieval warfare introduced new technology into BW. In 1422 at the siege of Carolstein, catapults were used to project diseased bodies into walled fortifications.

II. <u>The Era of Specific Disease Application:</u> 1763-1925. In 1763, BW took a significant turn from the crude use of corpses to the introduction of a specific disease "Smallpox." In the spring of 1763 Sir Jeffrey Amherst, the British Commander-in-Chief in North America, believed the western frontier, which ran from Pennsylvania to Detroit, was secure, but the situation deteriorated rapidly over the next several months. It became apparent that unless the situation was resolved, western Pennsylvania would be deserted and Fort Pitt isolated; owing to a lack of support from England and transportation problems, assigning additional troops was not an option. On June 23, 1763 Colonel Henry

Bouquet, the ranking officer for the Pennsylvania frontier, wrote to Amherst, describing the difficulties Captain Ecuyer was having holding the besieged Fort Pitt. His letter noted:

> *Unlikely the Small Pox has broke out in the Garrison, for which he has built a Hospital under the Drawbridge to prevent the Spreading of that Distemper.*

In his reply to Bouquet, Amherst added a crucial suggestion in a postscript.

> *Could it not be Contrived to Send the Small Pox among those Disaffected Tribes of Indians? We must, on this occasion, use Every Stratagem in our power to Reduce them. [signed]J.A.*

This suggestion is significant for several reasons. First, it clearly implies the use of smallpox as a weapon. Moreover, Amherst does not seem to find it necessary to spell out his stratagem, which suggests that such tactics had been used, or at least considered, in the fighting between Native Americans and European settlers.

Bouquet responded to Amherst's suggestion in a postscript to a letter dated July 13, 1763:

> *I will try to inoculate the _____ with Some Blankets that may fall in their Hands, and take care not to get the disease myself.*

Significantly, Bouquet added this postscript himself, in different ink. It is possible he did not want to alert his clerk to the plan, and official copies of the letter would not have contained the added note. Drawing a line instead of naming the Indians may have been an additional precaution. Amherst apparently approved the plan, noting in his response to Bouquet:

> *You will Do well to try to Inoculate the Indians, by means of Blankets, as well as Try Every other Methode, that can Serve to Extirpate this Execrable Race.*

There is evidence that Amherst and Bouquet were not alone in their plan to use biological warfare against the Indians. While they were deciding on a plan of action, Captain Ecuyer reported in his journal that he had given two blankets and a handkerchief from the garrison smallpox hospital to hostile chiefs with the hope that "it will have the desired effects." It appears that Ecuyer was acting on his own and did not need persuasion to use whatever means were necessary to preserve the Pennsylvania frontier.

The development of the science of bacteriology in the nineteenth and early twentieth centuries considerably expanded the scope of potential biological warfare agents. In 1915, during World War I, Germany was accused of using cholera in Italy and plague in St. Petersburg in 1915. There is evidence Germany used glanders and anthrax to infect horses and cattle, respectively, in Bucharest in 1916, and employed similar tactics to infect 4,500 mules in Mesopotamia the next year. Germany issued official denials of these accusations. Although there apparently was no large-scale battlefield use of biological warfare in World War I, numerous allegations of German use of such warfare were made in the years following the war. Britain accused Germany of dropping plague bombs, and the French claimed that the Germans had dropped disease-laden toys and candy in Romania. Germany denied the accusations.

Although chemical warfare was far more important than biological warfare in

World War I, the general awareness of the potential of biological weapons led the delegates to the Geneva Convention to include biological, agents in the 1925 Protocol for the Prohibition of the Use in War of Asphyxiating Poisonous or Other Gases, and of Bacteriological Methods of Warfare. The Geneva Protocol, as it has come to be known, banned the use of biological and chemical agents in war, but did not address the issues of research, development, production or stockpiling of these agents. While most nations ratified and signed this treaty, it was the subject of bitter debate in the U.S., was withdrawn from the Senate agenda by President Truman in 1947 and was not ratified by Congress until 1975.

III. The Era of Biological Weapons Laboratory/Field Research - The Golden Age, 1924-1972: In 1929, the USSR opened a BW research facility north the Caspian Sea. In the 1930's, both Japan and the UK initiated BW research programs.

The Japanese program was developed and run by Dr. (Major) Shiro Ishii.[5] His logic was that biological weapons must be effective or the Geneva Protocol would not have banned them. In 1932 he established a laboratory in Manchuria (Zhong Ma Camp). Human testing involved plague, cholera, glanders and typhus. This camp was destroyed in 1936, then Lt Col Ishii was appointed Chief of the Kwantung Army's Water Purification Units. There were at least 18 units established which in addition to water purification, were all involved in BW research. The center of the operation was Ping Fan, a suburb of Harbin, Manchuria. This was designated Unit 731. Other units were designated Unit 100 and Ei-1644. By the end of WWII, these units had studied the effects on humans of virtually every known pathogen, chemical pesticide, plant or animal poison. During the 13 years of Japanese BW research more than 10,000 human subjects were involved, all of whom either died or were killed. A small group of human remains studied by the Americans in 1947, anthrax accounted for 31 deaths, cholera 50, dysentery 12, glanders 20, mustard gas 16, tetanus 14, plague 106, salmonella 11, tuberculosis 41, typhoid 22, typhus 9. [6] At least 12 large scale field tests (cholera, typhoid, anthrax, typhus, plague) were carried out in China. After the war, many of the scientists became professors. Naito Ryiochi, Ishii's aide and director of the unit in Singapore, established the Green Cross Company, now a multinational pharmaceutical company. More than 5,000 Japanese were tried as war criminals, but not one high-level Japanese BW expert was ever charged with a crime.[5]

The British biological warfare project began on 12 February 1934. Analogous to the circumstances in Japan, in discussing the Disarmament Conference in Geneva, Sir Maurice Hankey told the Chiefs of Staff "whether it might not be right to consider the possibilities of this form (germ) of war."[7] Between 1937 and 1940 Britain began to stockpile vaccines, fungicides and insecticides against biological attack. In 1939, British Intelligence reported "The Germans and the Russians appear to have carried out considerable research on bacteriological methods of attack. Spraying of the virus of foot and mouth disease, dispersal of anthrax spores and pollution of water supplies." In fact, intelligence was in error. According to evidence presented at Nuremburg, the German decision to investigate BW was not taken until July 1943. However, the British BW lab was established in 1940 at Porton Down. By 1941, intensive research into offensive

biological weapons was underway. In the summer of 1942, scientists from Porton tested a bomb filled with anthrax spores on Gruinard, a small island off the northwest coast of Scotland, against lines of tethered sheep. In 1943, a bomber was used over the island. The Gruinard tests proved that BW was feasible. A total of 4 x 10^{14} spores were released in these tests.[9] The island,was still contaminated with anthrax spores in 1979.[9] It was finally decontaminated in 1987.

In 1941, the British Secret Service, in conjunction with the Special Operations Executive and Czech exiles decided to have Reinhard Heydrich (Hitler's choice as his successor) killed.[10] On 23 May 1942, in Prague, Heydrich was attacked with a grenade filled with botulinum toxin. He died on 4 June with classic symptoms of botulism.

In 1941, the US and Canada joined Britain in joint programs of BW research and development. Camp Detrick became operational as the center for as BW research in 1943. In the winter of 1943 the Allies began to manufacture a biological bomb, it weighed four pounds and was filled with anthrax spores - given the code name "N". It was designed by the British but manufactured by the U.S. In May 1944 an initial batch of 5,000 anthrax filled bombs came off the experimental production line at Ft. Detrick.[11] The entire production was turned over to the British. This facility could produce 50,000 bombs per month. The main center for U.S. production was built at Vigo, IN. It was capable of producing 500,000 anthrax or 250,000 botulism filled bombs per month. It was actually never used and was leased for the production of antibiotics after the war.

Following WWII, BW research continued unabated. The diseases considered most suitable as weapons were anthrax, brucellosis, tularemia and psittacosis, Q fever and VEE. In the 20 years following WWII, over 200 experiments using surrogate markers for BW agents were conducted in the U.S. against military and civilian targets. Between Sept 20-26, 1950, two Navy minesweepers released an aerosol of Bacillus globigii and Serratia marcescens outside the Golden Gate Bridge.[12] There were six mock attacks: 117 square miles were exposed, nearly every one of the 800,000 people in San Francisco inhaled $\geq$5,000 particles. Similar tests were carried out using zinc cadmium sulfide particles which could be detected chemically. In 1966 "harmless bacteria (Bacillus subtilis) were released through the gratings in the roofs of the New York subway.[12] Within minutes, the turbulence carried organisms throughout the system. Despite these experiments by 1969, the U.S. military concluded that BW had little strategic value on the battlefield, and in an age of nuclear weapons, its impact would be insignificant. Then on November 25, 1969 President Nixon announced that the U.S. would unilaterally renounce biological warfare and eliminate stockpiles of biological weapons. Once military leaders had discounted the value of BW, it became possible to negotiate, leading to the 1972 Convention on the "Prohibition of Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction." (known as the BWC). The BWC included treaty verification. The BWC was signed by 110 nations including the U.S. and entire Warsaw Pact.

Digressing from 1972, in 1963, the use of gas in the Yemeni War by the Egyptians and Russians was reported. Such reports were not believed. The attacks then stopped until January 5, 1967 when the town of el Kitaf was attacked. At 0730 hours on January 5,

1967, two MIGs circled the area and each dropped a smoke bomb--presumably to mark the village and to enable the pilots to judge the speed and direction of the wind. They were followed by nine Ilyushin 28 bombers which then dropped their bombs, three aircraft at a time dropping three bombs at each run. They all made three runs, thus 27 bombs in all were dropped. The bombs each made a black crater 3 feet deep and 6 feet wide and released the gas in a grey-green cloud which drifted with the wind over the village of el Kitaf. All but 5% of the people within 2 kilometers downwind of the bombs' impact point died or were seriously injured. About 120 died within 10 to 15 minutes of the attack, and a further 80 later on. Nearly all animals in the area died, mainly camels, goats, sheep, chickens, and dogs. Crops and vegetation in the area turned brown. Those who died did so with blood emerging from the mouth and nose, but they had no marks on the skin. Those who survived stated that the smell compared with fresh fruit or yeast. It affected their breathing and made them cough continuously.[13] Here is the report from Najran Hospital describing the survivors of el Kitaf and other towns attacked early in January 1967:[13]

A medical examination has been given to approximately 200 Yemenis in the town of Najran who are suffering from gas poisoning following the dropping of poison gas bombs by enemy aircraft on Yemeni territory. They were taken for first aid treatment to Najran Hospital, where the symptoms of the gas poisoning were diagnosed as follows: (1) Difficulty in breathing, with acute coughing; (2) Vomiting and the issuing of blood-flecked foam from the mouth; (3) Hemorrhage from nose and mouth; (4) Congestion of the face and eyes; (5) Hemorrhage of the conjunctiva [the mucous membrane lining the inside of the eyelids]; (6) Lowering of the blood pressure; (7) In some cases incapacity to walk or more; (8) In some cases total unconsciousness; (9) In some cases swelling around the neck and chest; (10) In some cases blood in the urine; (11) In some cases subcutaneous hemorrhage; (12) In some cases bloody stools.

The same scenarios occurred following the Russian invasion of Afghanistan in December 1979. Concurrently there were reports that the Hmong in Laos were being gassed by the Vietnamese. To investigate this further, a medical team lead by C.W. Lewis, MD, Chief of Dermatology at Brooke Army Medical Center, was sent to Laos in September, 1979.[14]

In Laos, Dr. Lewis established that the victims had three basic groups of symptoms and signs. They had terrible skin burns and burns to eyes, nose, and throat. They spewed blood from all their body openings. And they died in spasms and convulsions. These were the three main indicators, although scores of other lesser signs added to the conclusions.

There were only a few *known* chemical agents that could cause these symptoms. The burning would have to be produced by a vesicant or blistering agent. The convulsions by a nerve agent. At least, those were the only known types of agents that could produce exactly those effects.

Neither a blister agent nor a nerve agent, however, could produce the third effect of extraordinary bleeding. The killing agents seemed to fall in two types--a red gas and a yellow powder. Sometimes they were delivered together, sometimes separately. The yellow powder, which came to be called "yellow rain," seemed most often to cause the convulsions. The red mist seemed to cause massive hemorrhage. Were they just different

variations of the same chemicals?

A member of the team, Dr. William D. Tigertt, had been at the Army Medical Service Graduate School and Ft. Detrick in the early 1950's. He was well aware of the 1953 monograph "Acute Infectious Hemorrhagic Fevers and Mycotoxicoses in the USSR" prepared by D.C. Gajdusek in response to the occurrence of Korean Hemorrhagic Fever[15]. In the foreword, Dr. Smadel wrote "During the course of the search of the literature, it became evident that certain toxicoses caused by the ingestion of foods which had become spoiled by contamination with molds presented clinical and pathological manifestations in man which bore some resemblance to the infectious hemorrhagic fevers. Since information on these mycotoxicoses is also strangely lacking in the English literature, a portion of the monograph has been devoted to this subject."

Dr. Tigertt was familiar with mycotoxins and recognized that they could cause the three basic groups of symptoms and signs. Some have classified the mycotoxins as chemical agents, others as biological weapons, often they "fall between cracks" and are overlooked in discussions of BW or CW. There is little question that mycotoxins were tested in Yemen, Laos and Afghanistan. In the Iran-Iraq war (1984-1987), there is conclusive evidence that Iraq used vesicant sulfur mustard gas and the nerve agent tabun.[16] There are reports that the mixture also contained mycotoxins, but this has not been substantiated.[17] In view of the potential use of mycotoxin, I will include them in the discussion of specific agents. Iraq has also used sulfur mustard and sarin against the Kurds in Northern Iraq[18].

IV. <u>The Post Biological Weapons Convention Era, An era of proliferation:</u> 1972-present. Inexorably, violation followed the treaty. In 1974 the Russians had a secret organization, "Biopreparat," under the Ministry of Defense comprising 6 research labs, 5 on-line production plants and 15,000 employees.[19] Biopreparat has genetically engineered and weaponized antibiotic-resistant hypervirulent strains of tularemia and plague. Overall Russia had 55,000 people working in the BW program, they still have 25-30,000 (some of them are out for hire).

In April 1979, there was an outbreak of anthrax in Sverdlovsk (now Ekatorinburg) Russia. The epidemic occurred from 4-19 April with 96 victims, 17 cutaneous, 79 intestinal, of these 64 died. The U.S. attributed the outbreak to a leak from a secret military BW lab. The Soviets attributed it to cutaneous and gastrointestinal exposure to meat from animals infected with <u>B. anthracis</u>.[20] In 1992, according to Gen. Mironyerk, he received reports of mysterious deaths of reservists from Compound 32. They had all been outdoors between 7 and 8:00am in the open, downwind from Compound 19, the secret military BW lab. It was determined that someone had gone to work in Compound 19 early and failed to turn on the safety filters. During cleanup operation there were additional cases with 18 deaths.[21]

In 1992, two pathologists from Sverdlovsk provided slides, some gross organs and personal notes on 42 necropsies from the outbreak.[22] Pathologic lesions diagnostic of inhalation anthrax; hemorrhagic necrosis of thoracic lymph nodes and hemorrhagic mediastinitis were found in all 42 men. Focal, hemorrhagic,necrotizing anthrax pneumonia in 11 cases. <u>B. anthracis</u> was cultured in 20 cases. Mesenteric lymphadenitis occurred in

only 9 cases. These observations confirm that the Sverdlovsk outbreak was the result of an accident at a BW lab/plant. Subsequently, the plant has been relocated to the Lake Baikal area.

CURRENT TRENDS

In 1972 there were 4 countries with known BW capability. By 1992 there are 14 countries with offensive BW programs. These include: China, Cuba (R&D), Iraq, Israel (probable), Russia, Taiwan, Egypt (probable), N. Korea (probable), Iran (has fast track program in place), Syria.

TECHNICAL CONSIDERATIONS

I. Selection of Agents.
- A. Weaponization Criteria
  1. Infective via aerosol
  2. Aerosol stability
  3. High virulence
  4. Low infective dose
  5. High titer growth
  6. Low target population resistance/immunity
  7. Short incubation time
  8. High threat force protection
  9. Poor prophylactic treatment
  10. Difficult detection and identification
  11. High communicability
  12. Low persistence
- B. Potential Agents and Toxins
  1. Viruses
     - a. Arborvirus
       - (1) Alphavirus
         - (a) Venezuelan Equine Encephalitis
         - (b) Chikungunya
       - (2) Flavivirus
         - (a) Yellow Fever
         - (b) Russian Spring-Summer Encephalitis
       - (3) Bunyavirus
         - (a) Rift Valley Fever
         - (b) Crimean-Congo Hemorrhagic Fever
     - b. Arenavirus
       - (1) Lassa Fever
       - (2) Lymphocytic Choriomeningitis

(3) Arenaviral Hemorrhagic Fever (Junin/Machupo/ Bolivian/ Argentine Viruses)

c. Hantaan virus--Korean Hemorrhagic Fever

d. Ebola, Marburg Virus

e. Pox virus-smallpox

2. Bacteria

a. Anthrax (Bacillus anthracis)

b. Tularemia (Francisella tularensis)

3. Rickettsia--Q Fever (Coxiella burnetti)

4. Toxins--chemical compounds of biological origin that may be lethal on skin contact or skin injected, ingested or inhaled.

a. Sources of toxins

(1) Bacterial toxins--botulinum toxin

(2) Other Toxins

(a) Saxitoxin--from marine plankton

(b) Tetrodotoxin--oral poison from newt, puffer fish, and blue-ringed octopus

(c) Polytaxin--coelenterate (soft coral animal)

(d) Ricin--100 times as deadly as cobra venom; injectable poison from castor bean (seeds)

(3) Mycotoxins--fungal toxins; in particular the trichothecene group that contains T2, nivalenol, and deoxynivalenol toxins

C. U.S. Offensive Program: At the time of its termination major agents were tularemia, Q fever, VEE, not anthrax or botulinum toxin.

D. Soviet Priorities (≥ 15 likely to be used). (Gen AA Vorobyev)

Smallpox	26
Plague	23
Anthrax	21
Botulism	21
VEE	20
Tularemia	20
Q fever	20
Marburg	18
Influenza	17
Melioidosis	17
Typhus	15

E. Methods of Dissemination

1. Aerosol/respiratory route (explosive devices, spray devices):

a. Advantages

(1) Broad area coverage

(2) Difficult to detect

(3) Difficult to diagnose

(4) Increased severity and morbidity rate
(5) Achieve massive overdoses
(6) Pervasive

b. Disadvantages
(1) Inactivation by sunlight (UV), humidity
(2) Highly weather dependent (low cloud cover ideal)
(3) Onset of affect slower than other weapons

2. Gastrointestinal: (food, water, medications)
3. Percutaneous: Mycotoxins cross intact skin

F. Examples:

Biological Warfare Agents: Examples

Disease	Causative Agent	Incubation time (*days*)	Fatalities (*percent*)
Anthrax	*Bacillus anthracis*	1-5	80
Plague	*Yersinia Pestis*	1-3	90
Tularemia	*Francisella tularensis*	1-10	5-20
Cholera	*Vibrio cholerae*	2-5	25-50
Venezuelan equine encephalitis	VEE virus	2-5	< 1
Q fever	*Coxiella burnetti*	12-21	< 1
Botulism	*Clostridium botulinum* toxin	3	30
Staphylococcal enterotoxemia (food poisoning)	*Staphylococcus enterotoxin* type B	1-6	< 1
Multiple organ toxicity	Trichothecene mycotoxin	Dose dependent	

TABLE 1: COMPARATIVE LETHALITY OF SELECTED TOXINS AND CHEMICAL AGENTS IN LABORATORY MICE

AGENT	LD50 (µg/kg)	MOLECULAR WEIGHT	SOURCE
Botulinum toxin	0.001	150,000	Bacterium
Shiga toxin	0.002	55,000	Bacterium
Tetanus toxin	0.002	150,000	Bacterium
Abrin	0.04	65,000	Plant (Rosary Pea)
Diphtheria toxin	0.10	62,000	Bacterium
Maitotoxin	0.10	3,400	Marine Dinoflagellate
Palytoxin	0.15	2,700	Marine Soft Coral
Ciguatoxin	0.40	1,000	Marine Dinoflagellate
Textilotoxin	0.60	80,000	Elapid Snake
C. perfringens toxins	0.1 - 5.0	35,000-40,000	Bacterium
Batrachotoxin	2.0	539	Arrow-Poison Frog
Ricin	3.0	64,000	Plant (Castor Bean)
alpha-Conotoxin	5.0	1,500	Cone Snail
Taipoxin	5.0	46,000	Elapid Snake
Tetrodotoxin	8.0	319	Puffer Fish
alpha-Tityustoxin	9.0	8,000	Scorpion
Saxitoxin	10.0 (Inhal 2.0)	299	Marine Dinoflagellate
VX	15.0	267	Chemical Agent
SEB (Rhesus/Aerosol)	27.0 (ED_{50}-pg)	28,494	Bacterium
Anatoxin-A(s)	50.0	500	Blue-Green Algae
Microcystin	50.0	994	Blue-Green Algae
Soman (GD)	64.0	182	Chemical Agent
Sarin (GB)	100.0	140	Chemical Agent
Aconitine	100.0	647	Plant (Monkshood)
T-2 Toxin	1,210.0	466	Fungal Mycotoxin

(from Medical Management of Biological Casualties Handbook, U.S. Army Med Res Inst Inf Disease, Ft Detrick, MD, 1993)

G. Potential Impact

The potential impact of biological weapons is well illustrated by a World Health Organization publication from 1970. It was estimated that fifty kilograms of aerosolized anthrax, for example, dispensed by a line source 2 kilometers upwind of a population center of 500,000 unprotected people in ideal meteorological conditions, would travel greater than 20 kilometers downwind, and kill up to 220,000 people, or nearly half of the people in the path of the biological cloud. If tularemia were dispensed, the number of dead or incapacitated was estimated to be about 155,000.

SPECIFIC AGENTS

ANTHRAX

Etiology:
- ***Bacillus anthracis*** **(an extracellular pathogen, evades phagocytosis, multiplies rapidly in vivo)**
- **Virulence factors:**
  - **Capsular polypeptide - antiphagocytic**
  - **Anthrax toxin - 3 separate proteins;**
    - **PA protective antigen**
    - **EF edema factor**
    - **LF lethal factor**
- **Anthrax vaccines - human, contains PA**
  - animal, live loss of CP

Epidemiology:
- **Spores persist in soil, surface water pools**
- **Man more resistant than herbivores**
- **Most prevalent in herbivores; cattle, sheep, horses, goats**

Distribution:
- **World-wide**

ANTHRAX
— Clinical Features —

Types: **Cutaneous (95%)**
Inhalation (5%)
Gastrointestinal (<1%)

Incubation: **Several days**

Cutaneous:
- **Small red macule, over a week progresses to vesicular or pustular stage to an ulcer with a blackened eschar surrounded by brawny edema**
- **Most patients afebrile, minimal constitutional symptoms**
- **Course - 80-90% untreated heal, 10-20% disseminate**
- **Mortality very low with rx**
- Rx: Ciprofloxacin, doxycycline
  alt: Erythromycin, Penicillin G (IV then PO)

ANTHRAX

— Clinical Features —

Inhalation (Wool Sorters Disease)

Incubation: Several days

Initial Findings: Similar to severe viral respiratory disease

Course:
- After 1-3 days, acute phase; fever, dyspnea, hypoxia, shock
- Symmetrical mediastinal widening due to hemorrhagic mediastinitis
- Death usually within 24 hours
- Rx: Ciprofloxacin, doxycycline - 28-42 days
- Mortality: almost 100% with penicillin G Rx.

BOTULISM

Etiology:
- *Clostridium botulinum* (an anaerobe, survives in soil and marine sediments as spores)
- 8 distinct toxins (A, B, Cα, Cβ, D, E, F, G) a strain produces only 1 toxin
- Types A, B, E most commonly produce disease in man
- Spores are heat resistant, toxin destroyed by boiling 10 minutes

Pathogenesis:
- Toxins absorbed from stomach and small intestine. Not destroyed by trypsin.
- Toxin binds tightly to peripheral cholinergic synapses. Prevents release of acetylcholine. No effect on adrenergic fibers.

BOTULISM

— Clinical Features 1 —

Types:
- Gastrointestinal
- "Infant botulism"
- Wound (can be absorbed through lungs as an aerosol)

Incubation: 12-36 hours (range 6 hours - 8 days) after ingestion

Initial Symptoms:
- Weakness, lassitude, dizziness
- Nausea and vomiting (1/3)
- "Sore throat" due to dryness
- Postural hypotension

Concurrent with initial symptoms, may be delayed up to 3 days
- Diplopia, blurred vision, photophobia
- Dysphonia, dysarthria, dysphagia
- Symmetrical descending weakness

BOTULISM

— Clinical Features 2 —

Initial symptoms: (continued)	• Alert, oriented, afebrile • Ptosis, EOM weakness, dilated fixed pupils • DRs intact or decreased, no pathological reflexes • May show mild response to edrophonium (tensilon) • CSF normal
Course:	• Precipitous respiratory failure • Ileus • Urinary retention • Fever = nosocomial infection
Treatment:	• Antitoxin A, B, E (equine) • Guanidine HCl (investigational)
Mortality:	• 60% (with antitoxin - respiratory support - 25%)
Vaccine:	• Under IND

MYCOTOXICOSIS

(Yellow Rain, Alimentary Toxic Aleukia)

— Clinical Features —

Stage I	• Immediate to several hours after ingestion flat taste, tongue feels stiff, burning of throat, weakness, excess perspiration, insomnia. Temperature may increase to 102° F.
Stage II	• Symptoms decrease (lasts 2-3 days) • Leucopenia, thrombocytopenia (40,000-120,000/mm^3, lasts 3-4 weeks)
Stage III	• Petechiae (distribution chest, trunk, inner aspects of arms, thighs) • Exudative pharyngitis, temperature 102-104° F • Gastrointestinal bleeding • WBC 100-200/mm^3, platelets 20,000-80,000/mm^3 (lasts 2 days - 2 weeks) • Mortality 50%
Stage IV	• Recovery

from D.C. Gajdusek, AMSGS, 1953

DEFENSE AGAINST BIOLOGICAL AGENTS

I. Pre Attack[29]
   A. Immunization
II. During Attack[30]
   A. Mask (fitted, covering mouth, eyes, nose)
   B. Protective clothing
   C. Protective shelter
III. Post Attack
   A. Decontamination
      (1) Soap and water
      (2) 0.5% sodium hypochlorite, 10-15 minutes contact time (destroys botulinum toxin, not ricin or mycotoxin)
   B. Identification of disease
      (1) Immuno or chemoprophylaxis--(ciprofloxocin - 30 day supply for every soldier in Saudi Arabia, blister packs issued)[31]
      (2) Chemotherapy

TERRORISM AND BIOLOGICAL WEAPONS

Between 1980 and 1989 there were nearly 6,000 terrorist incidents world-wide, with 4,000 deaths and 11,000 injured.[23] Terrorism may be classified as "State-controlled terrorism" (Cuba, Iran, Libya, N. Korea, S. Yemen, Syria) and "autonomous terrorism," such as the Red Brigade, Shining Path, and many Arab groups. Is BW as worthless to terrorist as to the military? Perhaps not; if the objective is to destroy and terrorize but not be concerned about collateral damage, BW may be potentially well-suited. Indiscriminate violence practiced by some terrorist groups is reaching the level of mass destruction; crossing that threshold can be expected.

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