

Biological Warfare from Antiquity to World War I

Lecture No. 2

1. Outline

- Pre-scientific biological warfare
 - Slides (1 - 8)
- Initial use of biological warfare
 - Slides (9 - 16)
- The beginnings of scientific biological warfare
 - Slides (17 - 20)

2. Historical Allegations of Biological Warfare

- The siege of Thun l'Eveque (1340)
 - It has been suggested that siege engines were used to hurl dead horses into the castle forcing the defenders to evacuate
- The siege of Caffa (1346) and the 'Black Death'
 - It has been suggested that plague victims were catapulted into the fortified Genoese city of Caffa by Mongol forces and that the fleeing survivors carried the plague into Europe

3. Criteria to Assess Historical Allegations (i)

- It should make political and historical sense
- It should be supported with sufficient detail to allow evaluation
- The alleged action should be technically feasible in the context of the state of scientific knowledge at the time of the event

4. Criteria to Assess Historical Allegations (ii)

- The reported outbreak should be a plausible consequence of the alleged action
- The source of the allegation should be clearly documented
- There should be some evidence to support the allegation

5. Fort Pitt 1763 (i)

- Pontiac Indian rebellion unites tribes from New York to Virginia against British forces that are badly extended. Indian attacks overrun 8 forts and settlers are killed or captured in large numbers.
- Smallpox breaks out in Fort Pitt. William Trent commander of the civilian militia makes interesting notes in his journal after a meeting with the Indians.

6. Fort Pitt 1763 (ii)

- Trent's journal states that:
 - "...Out of our regard to them, we gave them two Blankets and a Handkerchief out of the Small Pox Hospital. I hope it will have the desired effect..."
- Fort Commander's ledger states that:
 - "To Sundries got to Replace in kind those which were taken from people in the Hospital to Convey the Smallpox to the Indians Viz:...."
 - 2 Blankets..... at 20/ £2..0..0
 - 1 Silk Hndkerchief 10/& 1 linnen do: 3/6 0.13.6"

7. Smallpox as a Biological Weapon (i)

- Epidemics amongst the American Indians killed more than 50% of many affected tribes
- Jenner's 1796 demonstration that infection with cowpox protected against smallpox led to widespread vaccination
- WHO global campaign 1967-77 eradicated the disease and vaccination is no longer ordinarily practiced

8. Smallpox as a Biological Weapon (ii)

- The infectious dose is low and as many as 10-20 second generation cases were often infected from a single case
- There would be an incubation period of 12-14 days plus several days before the rash was distinctive enough to suggest smallpox
- The population today would be largely lacking immunity

9. Koch's Postulates

- The microbe must be present in every case of the disease and absent from healthy organisms
- The suspect microbe must be isolated and grown in pure culture
- The disease must result when the microbe is inoculated into the healthy host
- The same microbe must then be isolated again from the diseased host

10. The 'Golden Age of Bacteriology'

- Some infectious diseases linked to microbial causes in the 'Golden Age'
 - Anthrax, 1876
 - Glanders, 1882
 - Brucellosis, 1887
 - Plague, 1894
 - Botulinum toxin, 1896
 - Tularemia, 1912

11. Biological Warfare in World War I (i)

- Germany carried out an extensive sabotage campaign using agents such as glanders and anthrax in an attempt to prevent valuable cavalry and draft animals such as horses being delivered to the opposing Allied Powers. The Campaign was:
 - Directed by the General Staff who probably saw earlier agreements as only restricting anti-personnel biological warfare
 - Biological sabotage in the USA was part of a larger campaign aimed at interrupting the flow of valuable war material
 - The central figure in the campaign was a physician Anton Dilger, born in the USA of German parents, but who had spent much of his life in Germany
 - Cultured agents were administered to horses in eastern seaboard ports by German seamen trapped in the US because of the British blockade

12 Biological Warfare in World War I (ii)

- The German sabotage campaign also extended to Romania. When Romania joined the Allied Powers in 1916 some of the cultures were discovered
- Also operations were carried out in Norway to attack horses and reindeer draft animals. Anthrax was in capillary tubes embedded in sugar cubes to be fed to the animals. Amazingly, one of the sugar cubes was discovered recently in a police museum and *Bacillus anthracis* identified by modern PCR methods
- Attempts were also made to sabotage supplies from Argentina
- Less is known about it, but France also carried out a similar anti-animal campaign on the western front

13. Anthrax as a Biological Warfare Agent (i)

- *Bacillus anthracis* is an aerobic, gram-positive spore-forming nonmotile species with very special characteristics for the bioweaponeer:
 - The life cycle involves vegetative growth in the victim – normally a herbivore – until the toxins produced cause death
 - Then when the animal dies the bacterium forms very environmentally resistant spores that protect the organism until it enters the next victim
 - The fact that the spores are so resistant to environmental degradation and the lethality is so high means that anthrax is an ideal biological weapons agent

14. Anthrax as a Biological Warfare Agent (ii)

- The accidental release of aerosolised anthrax spores from a military facility in Sverdlovsk in 1979 resulted in some 79 cases of anthrax and 68 deaths thus emphasising the dangerous nature of inhalation anthrax
- Spores deposited in the lungs are ingested by macrophages and transported to lymph nodes. Germination can take up to 60 days but once germination starts disease onset is very rapid

15. Anthrax as a Biological Warfare Agent (iii)

- It is estimated from primate data that the LD 50 (dose sufficient to kill 50% of people exposed to it) is between 2,500 and 55,000 inhaled anthrax spores
- Virulence requires the presence of an antiphagocytic capsule and three toxin components (protective antigen, lethal factor and oedema factor)

16. Anthrax as a Biological Weapons Agent (iv)

- Spores grow easily on ordinary media at 37 degrees and have a very characteristic appearance. Although identification should therefore be simple, few modern microbiologists will have encountered anthrax. Early signs of the disease are nonspecific complicating diagnosis
- Given the very rapid course of the infection once the spores have germinated early administration of effective antibiotics is essential to save victims
- Vaccination against anthrax is possible but not a practical proposition for the whole population
- Decontamination after an attack with aerosolised anthrax is a daunting proposition as demonstrated after the 'anthrax letters' attack with small quantities of anthrax in the USA in 2001

17. The 1925 Geneva Protocol

- Prior to World War I a series of international agreements had placed some restrictions on poisoned weapons
- Following the war there was discussion within the League of Nations of further restrictions
- These restrictions naturally concentrated on chemical weapons because of the large-scale use of chemical weapons in the war
- In 1925 arguments put forward by Poland ensured that the use of biological weapons was also covered in the 1925 Geneva Protocol

18. French Biological Warfare Preparations After the War (i)

- Concern over biological warfare led to the Trilliant Report of 1922 on “The use of bacteriological weapons in war”. This:
 - “...not only enables a detailed understanding of the motivation and reasoning behind the rapid expansion of the French programme, but also provided a scientific basis for the work.”
 - “...suggested that they [biological weapons] would be appropriate, especially during the period of mobilization, against such targets as civilian populations, urban centres, troop assembly points, barracks, stations, factories or industrial sites...”

19. French Biological Warfare Preparations After the War (ii)

- The Trilliant report:
 - “...evaluated microbial diseases that could have a military role and listed those which appeared useable...yellow fever, plague...brucellosis...and foot-and-mouth disease...”
 - “The section of the report on experimental work presented Trilliant’s findings on the aerial transmission of bacteriological agents and the influence of various factors on their dissemination...”
 - “...Trilliant stressed that laboratory trials had shown that it was possible to create artificial microbial clouds with all the physical properties of natural clouds...”

20. French Biological Warfare Preparations After the War (iii)

- “In the autumn of 1925 the War Ministry:
 - “...decided to direct research towards the development of ‘explosive bombs with special charges (microbial cultures) carried by aircraft’. The aim was to develop a device whose burst on ground impact would...produce clouds consisting of ...microorganisms...with the capability...of producing pathogenic effects...”
 - “...Full-scale trials were carried out in October 1926....Nine bombs were dropped from a Navy Goliath seaplane....The results of these tests were not only ‘favourable’ but they also enabled validation of the most important theoretical data...”

Sample Questions

- 1. Critically analyse the view that there are many examples of biological warfare in the historical record prior to the “scientific understanding” of the “microbial” causes of infectious diseases.**
- 2. How dangerous would smallpox would be if it was used as a biological weapon today?**
- 3. Describe the main phases of either the German anti-personnel biological sabotage campaign in World War I or the French offensive biological warfare programme between World War I and World War II.**
- 4. What is the 1925 Geneva Protocol? How did it come to cover biological warfare and what is its status today?**

References

(Slide 1)

- Geissler, E., and van Courtland Moon, J. (Eds.), (1999) *Biological and Toxin Weapons Research, Development and Use from the Middle Ages to 1945* (SIPRI Chemical & Biological Warfare Studies No. 18). Oxford: Oxford University Press.

(Slide 2)

- Horrox, R. (ed.), *The Black Death* (Manchester University Press: Manchester, 1994), pp. 14-26. p. 17.

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