Chemical & Biological Weapons

Achievements and Challenges

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The CBW threat spectrum

- War scenarios
- Terrorism
- Criminal acts

- Each will consider and have the availability of different CB agents, with different degrees of pathogenicity or toxicity
  - Depends on *intent*
  - Depends on availability
  - Depends on technical skills and structure of the organisation

What is chemical warfare?

Intentional application for hostile purposes of toxic substances against humans and their environment

- ***Blood agents***: prevention of oxygen transfer to tissues (e.g., phosgene)
- ***Choking agents***: interfere with breathing (e.g., chlorine)
- ***Nerve agents***: attack the central nervous system (e.g., sarin)
- ***Vesicants***: produce blisters (e.g., mustard agents)

- ***Incapacitating agents***: induce temporary physical disability or mental disorientation (e.g., LSD, BZ)
- ***Irritating agents***: induce temporary irritation (e.g., tear gas)
- ***Anti-plant agents***: herbicides, growth inhibitors, etc.

What is biological warfare?

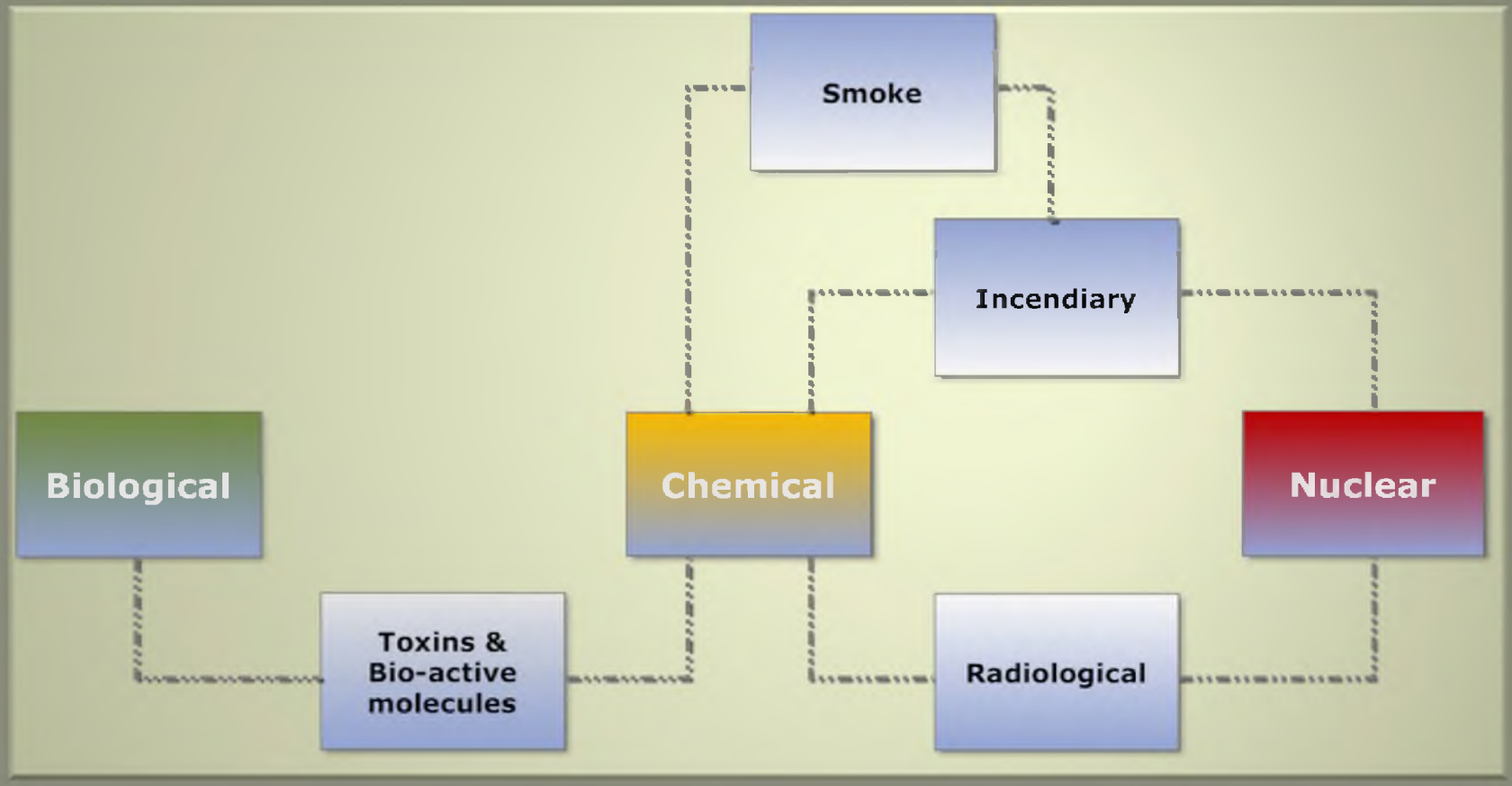
Intentional application against humans, animals or plants for hostile purposes of

- ***Disease-causing micro-organisms*** (e.g., bacteria);
- ***Other entities that can replicate themselves*** (e.g., viruses, infectious nucleic acids and prions)
- ***Toxins***, poisonous substances produced by living organisms (and their synthetically manufactured counterparts), including
  - micro-organisms (e.g., botulinum toxin),
  - plants (e.g., ricin derived from castor beans), and
  - animals (e.g., snake venom)

Alternative uses of CB agents

- **Against humans**
  - Potential for mass casualties exists, but not necessarily most likely scenario as agents difficult to acquire
  - Incapacitation
    - Wider range of agents available
    - Easier to collect from nature and cultivate
    - Delivery uncomplicated
    - Lower requirements for skills and functional specialization
- **Against animals and plants**
  - Economic impact
  - Agents easier to acquire; less of a risk to perpetrator
  - Easy to deploy
    - Many vulnerabilities in the food chain
- **Economic and societal disruption**
  - Goal is to disrupt functioning of utilities, commercial enterprises, public agencies
  - Wider range of CB agents available
    - Several can be commercially obtained
  - Exploitation of fear and lack of adequate preparations
  - Effectiveness of hoaxes

Non-conventional weapon categories



CW: Confluence of several trends

- **Emergence of chemistry as a science**
  - End 18th century; rapid development in 19th century
  - Development of new analytical and production methods
  - Toxic chemicals are manufactured; not derived from nature
- **Discovery and synthesis of new chemicals**
  - *Chlorine*: first preparation in 1774
  - *Phosgene*: first preparation in 1811
  - *Mustard gas*: compound (olefins) and its effects first described in 1860; sulphur mustard first synthesised in 1886
- **Industrialisation**
  - Second industrial revolution in the 2nd half of the 19th century
  - Commercial application of chemistry
  - Integration of science and large-scale production based on economic rationale
- **Education**
  - Permeation of science and technology throughout society
  - Impact on problem identification, analysis, and application of technical solutions in all sectors of society
- **World War 1**
  - Industrialisation of warfare (total war)
  - Forced integration of science, industry and military art

Foundations of biological warfare

- **Three critical characteristics of disease uncovered in 19th century:**
  - Infectious disease is caused by an agent (pathogen)
  - The agent can be transmitted from one living organism to another (infectiveness)
  - One agent is responsible for one disease only
- **Furthermore, it requires the ability to manipulate the pathogen**
  - Isolation
  - Cultivation (while maintaining its infectiveness)
  - Production in large quantities
  - Effective dissemination

Main prohibitions against CBW

- **1925 Geneva Protocol**
  - Prohibits the use in war of CBW
- **1972 Biological and Toxin Weapons Convention (BTWC)**
  - Comprehensive ban on development, production and possession of BW
  - Ban on BW use in Geneva Protocol + Final Declaration of 4th Review Conference (1996)
- **1993 Chemical Weapons Convention (CWC)**
  - Comprehensive ban on development, production, possession, and use of CW

The 'dual-use' challenge

- **Dual-use issues** arise when the attempts to control a particular technology confront the non-military commercial and scientific interests in such technology
- **Non-proliferation**
  - Control of access to technologies that may contribute to undesired weapon development in another state or non-state entity
  - Primary policy tool for weapon categories whose use in war or possession has not been wholly delegitimised (e.g., nuclear weapons, ballistic missiles)
- **Disarmament**
  - Total ban on development, production, transfer and possession of a weapon and preparations for its use in warfare (BTWC, CWC)
  - 'Dual-use' issue emerges when
    - Civilian facilities and installations need to be verified
    - Technologies underlying banned weapons have legitimate applications
    - Need to prevent the (inadvertent) assistance to development of banned weapon by another state or non-state entity
  - Ban of weapon (= single-use technology) is central; control of dual-use technology supports that central goal

New confluences in science and technology

- **Convergence of several scientific and technological domains:**
  - Biology and chemistry
    - Development of new generation of incapacitating agents
    - Manipulation of biochemical processes on sub-cellular levels
  - Nanotechnology
    - Construction of artefacts on the level of individual molecules or atoms
    - May also be useful for new CBW defence technologies, protection or detection
  - Informatics
    - Computer-assisted creation of new compounds and study of their properties
    - Increasingly fast design of new molecules / gene sequences : [illegible]
    - Simulation of processes
  - Engineering and process designs

- **Evolution of production processes:**
  - Modular production processes → may pose challenges for verification thresholds
  - Computer-steered production processes: consistent quality, reduced need for cleaning or interruptions for feeding (e.g., incubation or fermentation processes)

Evolving expectations from verification

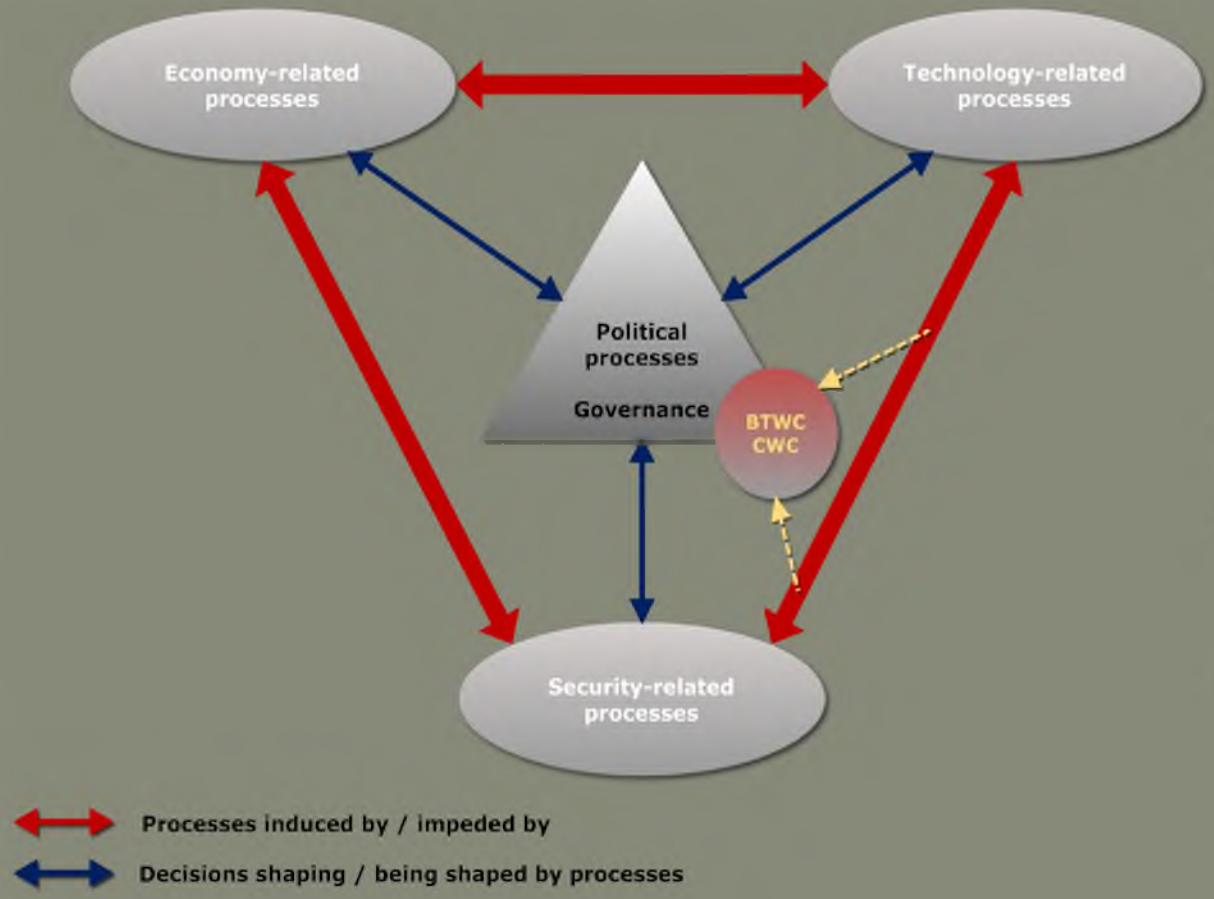
- **Cold war understandings of disarmament, verification & related procedures**
  - Difficulties in dealing with dual-use characteristics of technologies
  - No verification substitutes (e.g., visible & countable delivery systems)
  - Unease with roles of multiple stakeholders (civil society, scientists, industry, etc.) in the process
    - State is often more protective of stakeholder interests than the stakeholders
- **Major shifts in *management of uncertainty***
  - Shift away from parity in military arsenals (*adequacy*) to utility of weapons and hence capability to address challenges & threats (*effectiveness*)
  - Elimination of uncertainty in verification now primary demand (100% effectiveness)
  - Terrorism: military insignificant quantities form major security threat, but not captured by existing treaties
- **Shift away from *focus on weapons* as a problem (disarmament) to *focus on processes of enabling technologies* (non & counter-proliferation)**
  - Rogue state discourse (no trust) + emphasis on regime change
  - Addressing challenges of terrorist acquisition
- **Affects *possible verification concepts for BTWC* and *adaptation of CWC verification criteria and procedures* to new scientific, technological and industrial developments**

Entrance of the *post-proliferation era*?

- **Biological:**
  - Biology and biotechnology critical to development & health
  - Many developing countries conduct leading-edge research
  - Education expanding everywhere:
    - Geographical spread of knowledge to manipulate pathogens, including genetics
    - Banalisation of many research and development processes (e.g., introduction into secondary education; drop in cost of equipment and processes; etc.)
  - Biotechnology is essentially information: no physical goods to cross borders
  - Corporate acquisition and sell-offs

- **Chemical:**
  - Similar to biological
  - Many production facilities with potential for CW manufacture now in developing world (impact on organisation & cost of verification)

BTWC & CWC in a polycentric world



- No unified model for governance of weapon control anymore
- New stakeholders and security actors
- Increased role of non-state national & transnational actors
- Shifting relative balances of powers (economy, politics, military) and multiple power centres
- Geographical decentralisation of business and industry activities
- South-south trade patterns and impact on technology diffusion

- *Declining role of states in shaping developments, but many states reject formal governance responsibilities for non-state actors under BTWC*

THE TRENCH

Recalling where science, industry and military art converged
Challenging entrenched positions

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