

Future warfare

Session 8

GEOPOLITICAL GOALS

Territorial Defense

- Protect land and resources from takeover.
- Prevent loss by uprisings and propaganda.

Territorial Takeover

- Regain “lost” or “stolen lands”.
- Conquer disputed territories.
- Establish area dominance.

Biological Warfare
Chemical Warfare
Electromagnetic Warfare
Sound Warfare
Light Warfare

WEAPONS

Biological Warfare

- Also known as germ warfare: the use of biological toxins or infectious agents with the intent to kill, harm or incapacitate humans, animals or plants as an act of war.
- Biological weapons are living organisms or replicating entities (like viruses, which are not considered "alive").
- Entomological (insect) warfare is a subtype of biological warfare.

Biological Warfare

- **Offensive** biological warfare is prohibited under international humanitarian law and several international treaties.
- The 1972 Biological Weapons Convention (BWC) bans the development, production, acquisition, transfer, stockpiling and use of biological weapons, so the use of biological agents in armed conflict is a war crime.
- **Defensive** biological research for protective, prophylactic, or other peaceful purposes is not prohibited by the BWC.

Biological Warfare

- A biological weapon is about 0.05% of the cost of a conventional weapon to produce similar numbers of mass casualties per square mile.
- The technology used to produce vaccines, foods, spray devices, beverages and antibiotics is similar to that of producing biological warfare agents,
- A potential organism has an incubation period of 3 to 7 days, so terrorists get a head start and easily escape before government agencies start their investigations.

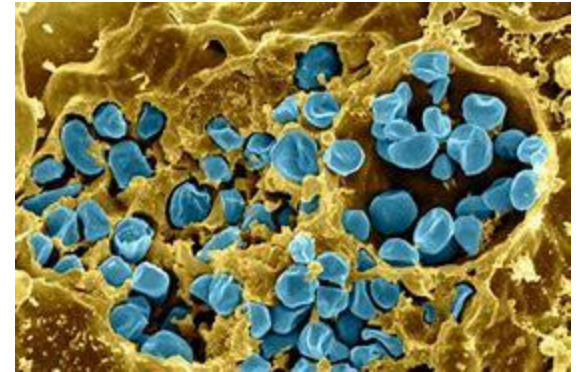
Biological Warfare

- A technique called Clustered, Regularly Interspaced, Short Palindromic Repeat (CRISPR-Cas9) is now so cheap and widely available that scientists fear that amateurs will start experimenting with it.
- In this technique, a DNA sequence is cut off and replaced with a new sequence that codes for a particular protein, with the intent of modifying an organism's traits.

Biological Warfare

Tularemia

- Infection caused by *Francisella tularensis*, produces fever, ulcerations, swelling of lymph glands, and sometimes pneumonia.
- Infects by entering through breaks in the skin or by being breathed into the lungs, and as few as 10 organisms can set off a serious bout of tularemia.
- *F. tularensis* can withstand low temperatures in moist soil, water, hay, and decaying carcasses for many weeks.



Biological Warfare

Tularemia

- Aerosol dissemination of *F. tularensis* will produce large numbers of cases of acute, non-specific, febrile illness about 3-5 days later, with *pleuropneumonitis* developing in a significant proportion of cases.
- Without antibiotics, it could progress to respiratory failure, shock, and death.

Biological Warfare

Cholera

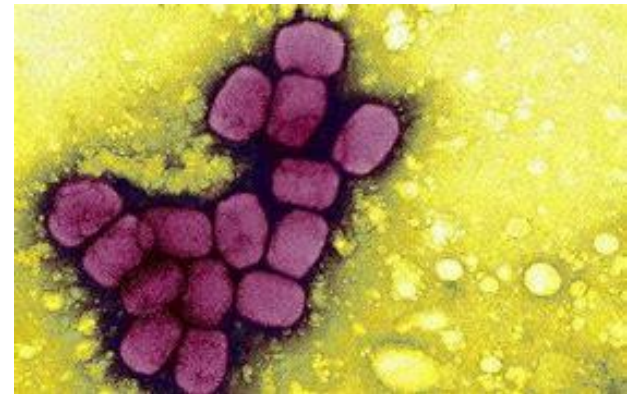
- Can possibly be used in bioterrorism, as a severe and sometimes deadly disease of the GI system.
- It does not spread easily from person to person, so it needs to be added to a major water source.
- The cholera bacteria, *Vibrio cholerae*, has been weaponized by the US, Japan, South Africa, and Iraq, among others.



Biological Warfare

Smallpox

- Can spread from person to person.
- World vaccination efforts stamped it out, with the last naturally-spread case occurred in 1977.
- The smallpox virus still kept in 2 laboratories,(1 in the U.S. and 1 in Russia), could be an effective weapon, spreading quickly and easily.



Biological Warfare

Anthrax

- A very likely organism to be used in a bioterrorism attack would be *Bacillus anthracis*.
- Found in nature, it is easily produced in a lab, has long survival in the environment, and can be released in powders, sprays, water, or food.
- In 2001, anthrax spores were sent through the US postal system, 22 people contracted anthrax, 5 of them died. The guilty party was never caught.



Biological Warfare

Plague

- *Y. pestis* is passed to humans by a flea that has fed on infected rodents.
- After infection, the disease can develop into bubonic plague (difficult to transmit, treatable with antibiotics), or pneumonic plague if it spreads to the lungs (develops rapidly and doesn't respond to antibiotics).
- The use of plague as a biological weapon is of great concern because:
 - the worldwide presence and availability of plague around the world
 - the capacity for mass production
 - aerosol dissemination
 - the high fatality rate of pneumonic plague
 - the potential for rapid secondary spread

The Oriental Rat Flea

Xenopsylla cheopis



Biological Warfare

Others germs considered to have potential as biological weapons include:

- brucellosis,
- Q fever
- Monkeypox
- arboviral encephalitides
- viral hemorrhagic fevers
- staphylococcal enterotoxin B.

Chemical Warfare



NUCLEAR WARFARE

Nuclear Warfare

- The most powerful and feared weapon that man has created, it has only been used twice by US in war with Japan.
- The effects were catastrophic: 8 square miles of cities were leveled, 140K people died instantly, and several tens of thousands more would die of radiation exposure.

Nuclear Warfare

- 9 countries currently have nuclear weapons: US, UK, Russia, France, China, India, Pakistan, Israel, and North Korea.
- The number of nuclear weapons in the world is actually down from 70K in 1986 to around 14K today.
- The US, UK and Russia have all been reducing their stockpiles, but China, Pakistan, India and North Korea are believed to be producing more.

Nuclear Warfare

- All nuclear powers boast and threaten to use their nuclear bombs.
- However, they are fearful of the self-harm consequences of using them.
- Retaliation and possible environmental poisoning for very long periods of time are powerful deterrents.

Sound Wave Warfare

- Sound has been deployed over the years to disrupt, confuse or even injure opponents on the battlefield.
- From the Israelite army of trumpet-blaring priests to the U.S. Navy's current use of long-range acoustic devices, sounds and sonic weapons have been used as a form of attack.

Sound Wave Warfare

- Sound has been mostly weaponized to disorient or anger opponents.
- In WWII, Soviet troops kept German forces awake at night by playing Argentine tangos speakers.
- In Vietnam, U.S. forces turned sound into psychological warfare by playing insults, tigers, the sound of tanks, and even Doris Day songs on the front lines.

Sound Wave Warfare

Infrasound and Ultrasound

- Sonic and ultrasonic weapons (USW) are weapons of various types that use sound to injure or incapacitate an opponent.
- Some sonic weapons make a focused beam of sound or of ultrasound; others produce an area field of sound.
- Very high-power sound waves can disrupt or destroy the eardrums of a target and cause enough severe pain or disorientation to incapacitate a person, while less powerful sound waves can cause nausea or discomfort.

Sound Wave Warfare

Long Range Acoustic Device (LRAD)

- The Pentagon deployed a sound weapon known as LRAD, or **Long-Range Acoustic Device**, which produces a 30 degree cone of audible sound in frequencies within the human hearing spectrum (20 Hz – 20 kHz)
- The LRAD was directed at Iraqis gathering at sites that had been the scene of suicide bombers.
- In Fallujah, US Army used Humvees with loudspeakers to hurl Arabic insults toward Al-Qaeda forces occupying the city.
- LRAD devices can be set to create pulses up to 149 dB: a jet engine 100 feet away registers 140 dB in comparison).

Sound Wave Warfare

Long Range Acoustic Device (LRAD)

- Some LRAD's are also advanced air-to-ground communication systems that broadcast loud, highly intelligible voice messages and attention-commanding warning tones.
- They can be clearly heard out to 2,000 meters over wind, engine noise and rotor wash.



Sound Wave Warfare

Havana Syndrome

- The attacks in Cuba affected nearly 2 dozen workers with unexplained headaches, dizziness, cognitive issues and sleep loss.
- The symptoms occurred after the intelligence agents and workers reported hearing strange noises.
- No weapon is known to cause all the reported symptoms, so it may have been a combination of chemical toxins and a low-frequency sound that disrupt the inner ear; weaponization of sound?

Sound Wave Warfare

- It's possible that devices somehow generate *infrasound* (below the human hearing range), like the low-frequency sound given off by the blades of windmill generators.
- Many people claim these machines make them sick, and there are several lawsuits from people who live or work near wind farms, and complain of headaches, dizziness and nausea.

Sound Wave Warfare

Infrasound and Ultrasound

- A 2014 study found that *infrasounds* can disrupt whistles (spontaneous otoacoustic emissions) made by the ear in response to noise.
- It is possible that the *infrasound* stimulated the part of the ear not dedicated to hearing: the vestibular system that controls balance, so symptoms won't appear immediately.

Sound Wave Warfare

Infrasound and Ultrasound

- Humans can't hear *ultrasound*, which is above 20 kHz.
- High-frequency sound dissipates quickly with distance and in tissues such as the ear.
- High-intensity, focused *ultrasound* is used for breaking kidney stones and cauterizing tissues in the body.
- If a covert acoustic device using *ultrasound* produced enough energy to permeate and damage the ear from far away, it would probably heat the head up.

Sound Wave Warfare

Infrasound and Ultrasound

- Animals exposed to high-intensity, focused ultrasound can experience lung and brain damage.
- A cruise line in the pirate-infested waters off Somalia has started using a long-range, military grade sound cannon that can cause permanent hearing loss at distances of up to 1K feet to deter hijackers.
- Companies developed a magnetic acoustic “sound laser”, that emits very painful, focused beams of sound to deter people from an area.
- The Israeli army has used a device known as "The Scream," which damages the inner ear, causing nausea and dizziness.

Sound Wave Warfare

Infrasound and Ultrasound

- A similar magnetic acoustic device, the Mosquito, has been used in the UK to deter teenagers from lingering around shops in target areas.
- It works by emitting an ultra-high frequency blast (around 19–20 kHz) that people under 20 are susceptible to and find uncomfortable.
- Age-related hearing loss apparently prevents the ultra-high pitch sound from causing a nuisance to those in their late twenties and above.

Sound Wave Warfare

Infrasound and Ultrasound

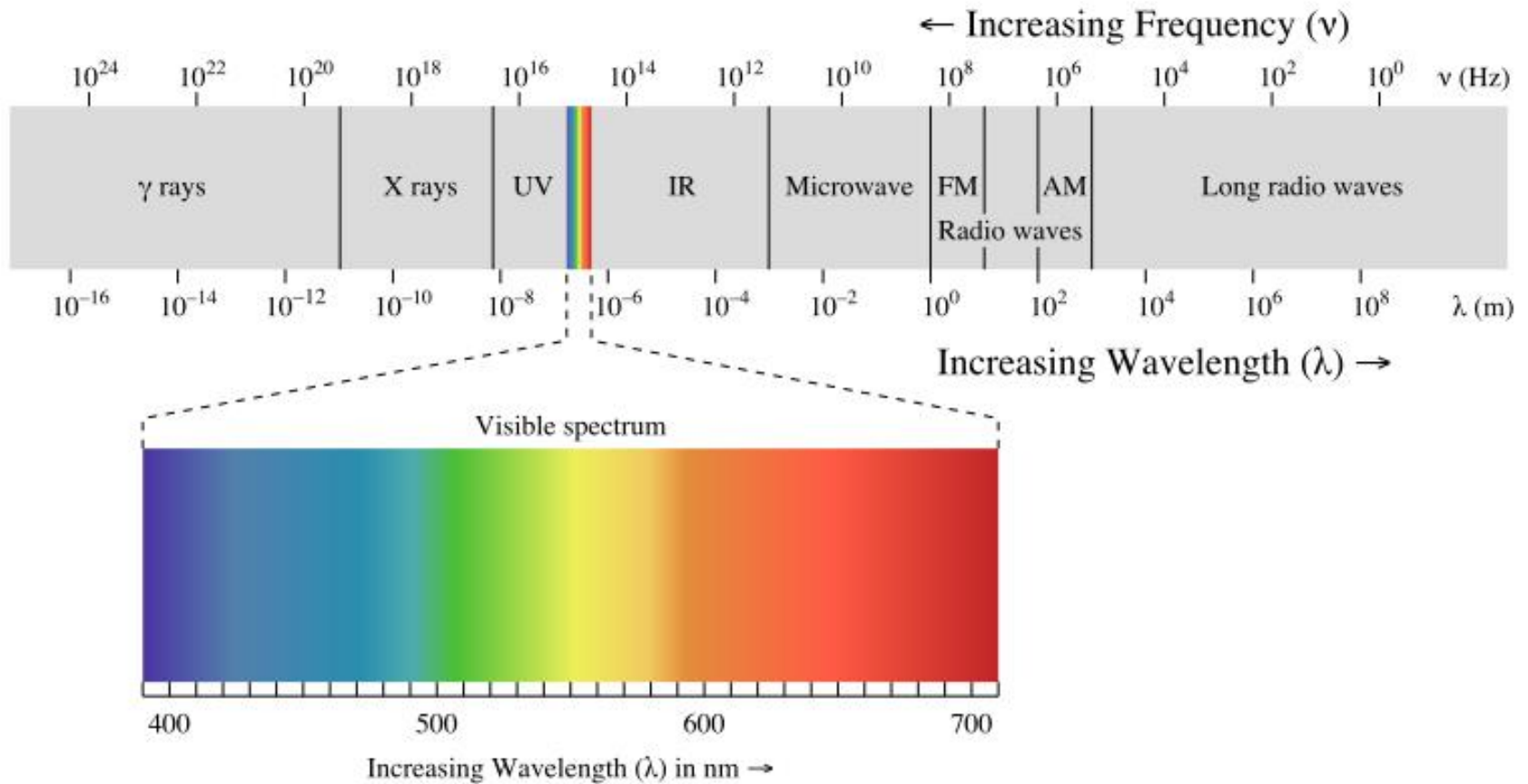
- It is possible for a device to produce frequencies that causes vibration of the eyeballs, and therefore distortion of vision.
- In 1995, a paranormal researcher found that a "haunting" characterized by a feeling of unease and vague glimpses of a grey "apparition" in his lab was caused by an extractor fan that was generating *infrasounds* of 18.9 Hz, 0.3 Hz, and 9 Hz.

Sound Wave Warfare

Microwave Auditory Effect (MAE)

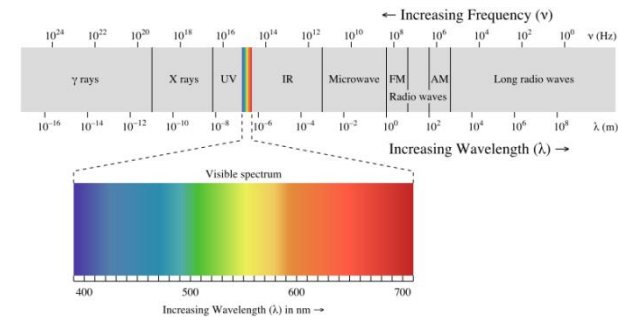
- U.S. Navy designed a MAE system called MEDUSA (Mob Excess Deterrent Using Silent Audio) to temporarily incapacitate personnel by remote application.
- The aim was to generate a **Microwave Auditory Effect** loud enough to cause severe discomfort and disperse crowds: a microwave “scream” inside your skull.
- Some researchers dismiss the effectiveness of the proposed MAE device, because human biophysics would cause the device to kill a person well before they were bothered by the noise.
- There couldn't be a hazard from the sound, because the heat would get you first.

Electromagnetic Spectrum



Light Warfare

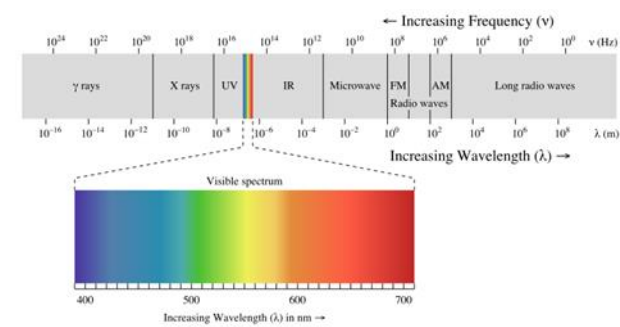
Electromagnetic Spectrum



- The visible spectrum (light that we can see with our eyes) makes up only a small fraction of the different types of electromagnetic radiation that exist.
- To the right of the visible spectrum, are the types of energy that are lower in frequency (and thus longer in wavelength) than visible light, like *infrared* (IR) rays, microwaves, and radio waves.
- These surround us constantly, and are not harmful, because their lower frequency waves are lower in energy, and thus are not dangerous to our health.

Light Warfare

Electromagnetic Spectrum



- To the left of the visible spectrum are *ultraviolet* (UV) rays, X-rays, and gamma rays, which are harmful to living organisms, due to their extremely high energies and high frequencies.
- This is why we wear suntan lotion at the beach and why X-ray techs will place a lead shield over parts of the body not being imaged.
- Gamma rays, the highest are the most damaging, but our atmosphere absorbs them from outer space and protects us from harm.

Light Warfare

Electromagnetic Spectrum

- Electromagnetic waves are a by-product of both electric and magnetic fields, they do not require the presence of any medium, and can travel through a vacuum.
- Sound is a mechanical wave, requires the presence of a medium, and works by pushing and traveling through the medium's molecules so sound is vibration in the medium which comes to our ears for our brain to analyze it.

Light Wave Warfare

Laser Beams

- Concentrated high intensity light beams, like lasers, can injure eyesight with permanent damage to retinas.
- Short exposure time can harm an army's eyes.
- Troops need protective goggles.

Light Wave Warfare

Laser Beams

- Highly aimable, they can activate devices.
- Laser beams have minimal dispersion or loss over long distances.
- They are invisible and do not produce heat.
- Could be aimed from space.

WAR TACTICS

Conventional

- Normal artillery will become obsolete.
- AI-guided anti-missile rockets can hit targets between continents.
- Bombardment can be done by remote control unmanned flying aircraft.
- Missiles can be launched from submarines.

Scorched Earth

- Large swathes of land can be rendered barren, useless for living or cultivation for years.
- Different chemicals can act as defoliants or as contaminants to the soil.
- Destroying the viability of the land can cause human disease, hunger and inability to fight.

Water Poisoning

- Water can be made harmful by mixing in:
 - Toxins
 - Infectious materials
 - Hormones or bioactive substances
 - Radioactive minerals
- Diseases in the inhabitants of an area cause serious disruptions in the food chain, the workforce and productivity.

Infrastructure Disruptions

- Power grid:
 - Intermittent interruptions (brownouts)
 - Long-term interruptions (blackouts)
 - Total widespread shutoffs
- Telecommunications:
 - Cell tower interruptions
 - Consumer radio and/or television jamming
 - Radio communications with planes
- Water supply
 - Quantity (distribution amount)
 - Quality (tainting, infection)

Light

Deprivation

- Light deprivation causes serious depressive behavior and damage in brain regions known to be underactive in humans during depression.
- During depression, neurons that produce norepinephrine, dopamine and serotonin (neurotransmitters involved in emotion, pleasure and cognition) are in the process of dying (apoptosis).
- Apoptosis, with compromised synaptic connections, may be the underlying cause of the darkness-related blues of Seasonal Affective Disorder (SAD).

Light

Deprivation

- The dark-induced effects stem from a disruption of the body's clock.
- If the circadian system is not receiving normal light, that might lead to changes in brain systems that regulate mood.
- This might be very relevant to seasonal affective disorder (SAD), and to depression overall.

HUMAN COMPONENT

Future Warfare

Human Component

Future soldiers will be equipped with:

- Constant radio communication with others
- Infrared night vision goggles
- Exoskeleton to increase strength & stability
- Nylon/Kevlar body armor
- Mask & gloves to shield from atomic radiation
- Back jet pack to vault across trenches
- High power ray/projectile weapon
- Lightweight bulletproof helmet covering ears



3/21/2023

©NAR OLLI @ University of Illinois



↑
Soldier of the future with exoskeleton 2018

←
Soldier of the future (LIFE) 1959

Future Warfare

Human Component

- Soldiers will not be part of a mass attack troop.
- There will be more individual/small group task forces performing specific missions.
- The built-in 2-way communication device in the bulletproof plastic helmet will help in running and coordinating missions.