# Map of nanotech global catastrophic risks

Time

Risk: Negligible global risk → Some risk → High risk

## 2020 Nanoparticles

### Toxicity of nanoparticles

• In general nanotubes and fullerens are not toxic
• Some types of nanoparticles can penetrate into lungs and blood resulting in allergic reactions and inflammation, wiki
• It looks like a hypothetical nano-particles toxicity issue was raised to distract attention from more remote and serious risks of nanotech.
• But caution is needed because some kind of very toxic nanoparticles may yet be found.

### Targeted nanoparticles

• Are used in medicine
• May be used to deliver toxins and genes
• *They are lipid balls with attached ligands*

### Simple nanomechanic without computers

• Could be used in new types of biological weapons
• *Made on DNA-origami*

«As an example, the smallest insect is about 200 microns. This creates a plausible size estimate for a nanotech-built antipersonnel weapon capable of seeking and injecting toxin into unprotected humans. The human lethal dose of botulism toxin is about 100 nanograms, or about 1/100 the volume of the weapon. As many as 50 billion toxin-carrying devices — theoretically enough to kill every human on earth — could be packed into a single suitcase».

## 2030 Micro-robots

### Microdrones

Intelligence and delivery of explosives

### Microbots 10 mm size

• Artificial bees, with poisonous bites
• Traditional manufacturing method

### Microbots 1 mm size

• Artificial fleas, delivery of toxins and bio-weapons.
• Lithographic printing of details

### Microbots 100 mkm size

• Delivery of botulism toxin (Lethal dose is 100 ng)
• Cheap lithographic production with elements of self-assembling and growing using biological parts

### DNA-origami robots

Remote controlled nanobots not capable of replication

## 2040 Nanorobot-replicators

### Accidential Grey goo: ecophagy

• Self-replicating nanobots eating carbon could kill all of the biosphere in two days.

• Preventive measures for accidental release are known: nanobots must depend on rare materials for replication; most tasks can be solved without creating replicators.

### Green goo: bionanobots

• Unlimited replication of specially designed bioagent.

• Living cells, capable of synthesizing mechanical details using DNA-origami and programmable for any task.

### Speed up of AI creation, which could be unfriendly

• Brain scanning using nanobots will provide secrets of the human mind.

• Creation of computronium: very powerful computers will enable quicker AI arrival.

### Dimming and cooling of the atmosphere

• Nanobots will use solar radiation for power and atmospheric CO2 for material.

• If they fly high in the air and consume CO2, it will result in a new Ice Age.

• Grey plankton, more in Freitas article

### Brain control

• Creation of effective neuro-implants, which may be installed secretly and control human behavior.

• Neuro-implants and other prostheses may be hacked by computer virus (globally) causing harm and death.

### Terrorist grey goo attack

Nanobots may be specially designed to cause extinction event, which could be achieved in several stages:

1. Secret dissemination through earth's surface in small quantities
2. Replication
3. Attack on infrastructure and humans.

### Molecular Nanomanufacturing

• Any arms can be created in almost unlimited quantities, including missiles, drones, robots; weapons of mass destruction become self replicating.

• Filtration of uranium from ocean water, isotope separation using nano-filters and the creation of large nuclear stockpiles and enormous bombs (hundreds of gigatons)

• Creation of large scale infrastructure, including bombs and weapons.

• Instant colonisation of solar system starting by one single replicating space robot, and the creation of potentially dangerous large objects within it including artificial asteroids and thermonuclear ignition of gas planets.

### Private nanoprinters

• Can print any weaponry (even now it is possible to print a gun)

• Could print living matter including viruses.

• Could print self-replicating nanobots.

• May be infected by computer viruses which will make them print dangerous things including bombs and replicators.

• Protection ideas: constant cryptographic connection with service centre to prevent jailbreak.

### Nanotech weapons

Clouds of nanobots capable of self-replication, short-cutting circuits, killing living force, creation Utility For and self-assembling in large-scale assault weapons.

### Unstable arms race

Nanotech allows the secret development of arms, control is difficult and even a private person could gain an advantage if they started creating a nano-infrastructure first.

## 2050 Nanoshield

Global protection system from nantoech risks

### Nanoshield failure

• Wrong command

• Autoimmune reaction

• War between two shields

### Nanoshield elements

• Surveillance system: local and space-based

• Non-specific defence: dispersed nanobots

• Ideal: most matter is converted into nanotech, no unprotected resources exist

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