The Biological Weapons Ban and Scientific Progress

Rapidly developing life sciences produce many exciting and useful innovations, for example in the fight against disease. However, with such powerful advancements also comes the possibility of military misuse. There is therefore an urgent need to strengthen the Biological Weapons Convention. The results of the Ninth Review Conference of this Convention may make this possible.

By Sophie Reiners and Oliver Thränert

The Biological Weapons Convention (BWC), which entered into force in 1975, bans an entire category of weapons of mass destruction. The BWC came into being at a time when the former Soviet Union would not allow on-site verification of compliance. Thus, while the BWC establishes an important international norm against biological weapons, its lack of effective verification measures renders it a rather weak treaty. This weakness is even more important today, as rapid advances in biological and life sciences could lead to the emergence of knowledge and capabilities that are easily capitalized on, or even misused, by militaries. Moreover, scientific disciplines such as biology and chemistry are increasingly merging. The Chemical Weapons Convention (CWC), which, unlike the BWC, has effective verification elements and a dedicated organization to enforce the ban on chemical weapons, has been in force since 1997. The fact that the BWC and the CWC are so different in terms of their verifiability could become a growing problem. This is why the recent decision of the Ninth Review Conference of the BWC, to develop, if possible by 2025, measures that will contribute to the effective strengthening of the BWC in all its aspects, is so welcome.

A biohazard sign is displayed in the bio-containment facility of the Spiez Laboratory in Switzerland in June 2022. *Jennifer Rigby / Reuters*

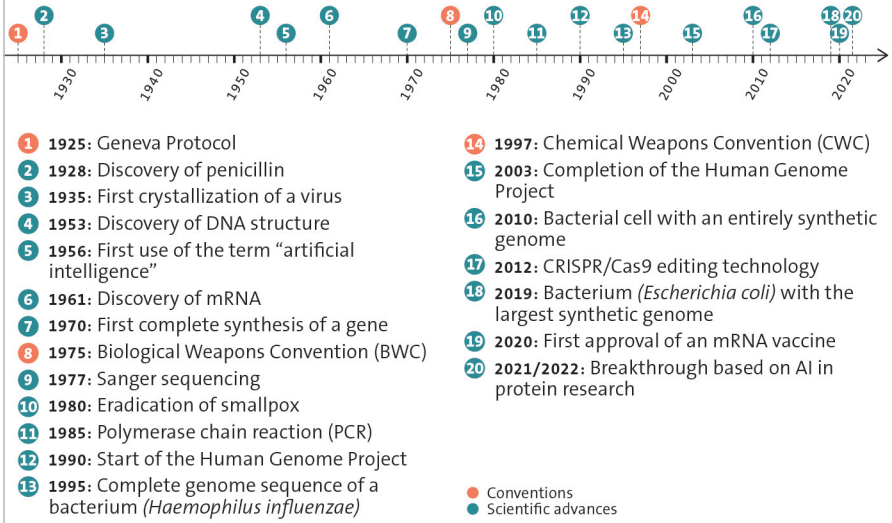
Pathogens as Weapons

Pathogens and toxins have been used for hostile purposes since ancient times. It is documented that in 1763 British troops gave blankets infected with the smallpox virus to Native Americans with the aim of decimating the Indigenous population. During the Second World War, Japan used pathogens such as plague in occupied Manchuria. The USA, Britain, Canada, the German Reich, and the Soviet Union maintained biological weapons programs throughout the War, some of which were quite extensive. Many were continued during the Cold War, particularly by the United States and the Soviet Union. While US

President Richard Nixon unilaterally renounced the US offensive biological weapons program in 1969, the Soviet Union intensified its activities in this field after the BWC entered into force. The "Biopreparat" project, which was disguised as a civilian project and spread throughout the country, built up the capacity to produce large quantities of smallpox virus and anthrax bacteria for military purposes at short notice. Open-air propagation experiments were carried out on an island in the Aral Sea. After the collapse of the Soviet Union in 1991, the Russian Federation admitted to violations of the BWC.

Iraq under Saddam Hussein also had a biological weapons project. It was dismantled and destroyed in the 1990s after Iraq's defeat in the 1991 Gulf War. Furthermore, terrorists have also been involved in the development and use of biological weapons. For example, the Japanese Aum Shinrikyo sect worked with anthrax bacteria in the 1990s, and also attempted to gain access to the Ebola virus. In 2001, envelopes containing anthrax bacteria were mailed – presumably by a single perpetrator – to members of the US Congress and others in the US, killing five people.

Arms Control and Scientific Progress



The Biological Weapons Convention

Negotiations in the then Eighteen Nation Committee on Disarmament initially sought a treaty banning biological and chemical weapons. Such a treaty would have been logical since as early as 1925, the Geneva Protocol banned the use of chemical and bacteriological agents in war. However, a British proposal in July 1969, and a subsequent US decision in November of the same year, to unilaterally renounce biological but not chemical weapons changed the dynamics of the negotiations. At the time, Western militaries considered biological weapons to be of little military use and of little strategic importance. The Soviet Union, however, took a different view. Soviet political leadership saw a treaty banning biological weapons as a useful tool within their policy of détente; the Soviet military, on the other hand, did not trust the West to restrict biological weapons. However, since in practice a ban without effective verification would not prevent the intensification of the Soviet biological weapons program, they did not oppose it.

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Importantly, the BWC does not provide for legally binding declarations that could be verified through on-site inspections. Accordingly, there is no BWC organization dedicated to implementing the treaty's provisions, only a small Implementation Support Unit. In the event of a suspected violation, States Parties can only consult with each other or refer the matter to the UN Security Council, which can take further action such as sanctions or military action under the UN Charter. In the case of the former Soviet biological weapons program, the UN Security Council was not mandated to investigate it because of the Russian veto. Instead, a trilateral process involving the US and the UK was intended to fully disclose the program but failed. Reciprocal laboratory visits were halted before all former Soviet biological weapons laboratories could be inspected.

While inadequate verification measures hindered the BWC from the outset, its negotiators were far-sighted enough to include conceivable future scientific developments in the definition of the subject of the ban. First of all, the BWC does not impose any restrictions on basic research. Also the BWC purposefully avoids a definition of biological weapons that could be considered outdated by future scientific developments. Instead, it uses a "general purpose criterion". According to the BWC, States Parties may never produce biological agents and toxins of types and in quantities that are not justified for prophylactic, protective or other peaceful purposes. It is precisely the vagueness of this provision that ensures that the ban on biological weapons will continue to apply in the future, regardless of scientific and technological advances. However, weapons, equipment and means of delivery related to the use of biological agents and toxins for hostile purposes are prohibited under the BWC. At the same time, the States Parties to the BWC agreed to maximize the exchange of materials, equipment, and information for the peaceful use of biological agents and toxins. One of the greatest challenges is to effectively implement the BWC in the face of rapid scientific change.

Scientific Progress

Life sciences are advancing at an ever-increasing pace. With these developments, come great benefits to society, not least of which is that diseases can be more effectively prevented, diagnosed, and treated. The scale of accelerating scientific change can be illustrated by the example of the Human Genome Project. By 2003, more than 90% of the human genome had been sequenced. It took more than a decade and the project cost about three billion USD. In 2021, an American research team sequenced a human genome in just over five hours. The cost of whole genome sequencing had also dropped dramatically, to less than a thousand USD.

Another example is the development of mRNA vaccines in the wake of the Covid-19 pandemic. Although the corresponding mRNA technology had been researched for about thirty years, primarily for cancer therapy, few would have expected that it would be possible to bring effective coronavirus vaccines to market in such a short time.

The newly developed coronavirus vaccines symbolize the progress in biotechnology and synthetic biology, which currently attracts significant investments. Improvements in DNA synthesis and the assembly of DNA sequences make it possible to reconstruct entire genomes. Synthetic viral genomes are used, for example, in the development of vaccines. Scientists are trying to develop increasingly complex synthetic cells that should mimic the structure and behavior of natural cells. In addition, the cost of technologies like DNA synthesis is falling. As a result, the number of commercially available "benchtop DNA synthesizers" is growing, allowing a greater number of people to access the technology to make synthetic DNA in their own laboratories.

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A particularly powerful development has been the creation of and subsequent widespread adoption of the genome editing method CRISPR/Cas9. The CRISPR/Cas9 system allows researchers to selectively cut and modify DNA sequences. The rapid development of CRISPR technologies is for example opening up new possibilities for curing hereditary diseases.

As a result of advances in synthetic biology, chemistry and biology are increasingly merging. They are also converging with other disciplines, such as engineering and computer science. The interplay of technologies in molecular biology with artificial intelligence (AI), machine learning, and a high degree of automation is accelerating the development of new biomedical products. Highly automated facilities called "biofoundries" can automate the "design-build-test-learn" cycle and therefore accelerate and optimize the manufacturing and validation of biological systems. Similar to biofoundries, "cloud labs" will allow chemical or biological experiments to be planned and performed remotely in robot-controlled laboratories. In the future, quantum computers could further advance the research and production of drugs and vaccines. In 2021, a major AI-based breakthrough was made in predicting 3D protein structure based on amino acid sequence alone. With the publicly available AI-generated protein databases, protein structures can now be predicted in a very short time, which opens up new possibilities for drug development. The following year, the ability to design proteins *de novo* using AI was developed. Researchers can now design proteins that do not exist in nature.

Advances in the life sciences are opening up countless new opportunities in the areas of health, society, and the environment. However, as scientific and technological advances increase, so does the risk of misuse. In 2018, a Canadian research team made headlines when they reconstructed the horsepox virus from synthetic DNA (*de novo* synthesis). This was part of a research project to create a safer vaccine against human smallpox. Horsepox poses no threat to humans. Nevertheless, critics feared that the published protocols could be misused to synthetically produce human smallpox. Another example is the ability to identify highly toxic substances using artificial intelligence. A team of American pharmaceutical researchers demonstrated in an experiment that it is possible for an AI software normally used in pharmaceuticals can find 40 000 highly toxic molecules in less than six hours. Some may be more toxic than the extremely toxic neurotoxin VX.

The World Health Organization defines "Dual Use Research of Concern" as research that is intended to provide a clear benefit, but which could easily be misapplied to do harm. A potential misuse could occur through state or non-state actors. Dual-use research includes, for example, research on dangerous pathogens that could increase their infectivity or disrupt the effectiveness of an immunization against an agent. Against this background, it is necessary to sensitize researchers as well as all other actors involved, from funders to research publications, to the potential for misuse. Above all, the rapid advances in research make an effective strengthening of the BWC an urgent necessity.

The Ninth Review Conference

At BWC Review Conferences, which take place every five years, States Parties have repeatedly sought to strengthen the Convention. They have agreed to political, but not legally binding, confidence-building measures to ensure greater transparency. These include, inter alia, the notification of high containment laboratories and the exchange of information on biological protection programs. From 1995 to 2001, negotiations even took place on a legally binding Additional Protocol, with the aim of strengthening verification in particular. The draft provided for various forms of reciprocal on-site visits. At the 2001 Review Conference, however, the United States rejected this draft as impractical, with the tacit approval of other States Parties such as Russia and China. Since then, annual meetings of states and experts ("intersessional process") have been held as a substitute. They deal with issues such as national measures to implement the BWC or codes of conduct for scientists against the background of a rapidly changing scientific and technological environment.

Notwithstanding the difficult political climate created by Russia's war of aggression against Ukraine, the Ninth Review Conference of the BWC, held in Geneva from 28 November to 16 December 2022, opened up promising prospects. If realized, they could lead to a substantial strengthening of the BWC. This is all the more astonishing given that, prior to the Review Conference, Russia leveled serious accusations against Ukraine and the United States, alleging that Kyiv, with US financial support, was operating biological laboratories where work was allegedly being carried out in violation of the BWC. Moscow initiated a formal consultation under Article V of the

Spiez CONVERGENCE

Spiez CONVERGENCE is a biennial international conference held in Spiez **since 2014** and is organized by the Spiez Laboratory with the support of the Federal Department of Foreign Affairs (FDFA), the Federal Department of Defence, Civil Protection and Sport (DDPS) and the Center for Security Studies (CSS). It is **part of the Federal Council's Arms Control and Disarmament Strategy.**

At the conference, scientists from top research institutions as well as experts from industry and scientific policy advice discuss the latest developments in science and technology and their possible impact on the conventions banning chemical and biological weapons. (see Spiez CONVERGENCE report 2022)

BWC, which was inconclusive. Subsequently, Russia even attempted to refer its concerns to the UN Security Council under Article VI of the BWC, but this was rejected. Nevertheless, Moscow also brought the matter to the BWC Review Conference. First, it abandoned its participation in the Eastern Regional Group because it felt blocked by another member on procedural issues and declared itself a "Group of One". Moreover, Russia prevented the otherwise customary adoption of a text on the review of the implementation of the individual articles of the BWC, because it was not successful in inserting formulations on possible US and Ukrainian misconduct into the text.

There should be no illusion that there is a wide divergence of views on how to strengthen the BWC.

The United States was instrumental in making the progress that was made possible. Washington, which for many years had resisted any debate on verification of the BWC, was eager to take steps to strengthen the BWC. The United States received support from a united European Union given its member states wanted to bring the conference, held under the Italian presidency, to a successful conclusion. Moreover, the non-aligned members of the BWC did not want to be instrumentalized by Russia.

Against this backdrop, States Parties agreed again to continue with the "intersessional process" from 2023 until 2026 and to extend the mandate of the Implementation Support Unit, which previously consisted of three persons, and to add a fourth. Furthermore, it was also possible to establish a new working group. The group, open to all States Parties, is to prepare a report, to be adopted by consensus by the end of 2025 if possible, on: 1) international cooperation for peaceful purposes; 2) scientific and technological developments relevant to the BWC; 3) confidence-building measures and transparency; 4) compliance and verification; 5) national implementation of the BWC; 6) assistance in preparing for protection against possible biological attacks and; 7) organizational, institutional, and financial arrangements.

The group will meet for 15 days each year in Geneva for substantive meetings until 2026. The first substantive meeting is scheduled to take place in August 2023. The final report should identify, analyze, and make recommendations on measures, including possible legally-binding measures, aimed at strengthening the BWC in all its aspects. Particular attention will be paid to the establishment of a mechanism for international cooperation for peaceful purposes, as well as to the development of a procedure for assessing scientific and technological developments relevant to the BWC.

The biggest positive surprise of these agreements is that after more than twenty years, when negotiations on an Additional Protocol were suspended, States Parties are now making a renewed effort to address more intensively the issue of verification of the BWC. This is urgently needed given the rapid advances in the life sciences. However, there should be no illusion that there is a wide divergence of views on how to strengthen the BWC. Finally, international cooperation for peaceful purposes is more important to many countries than verification of the BWC. Nevertheless, a new beginning is possible. After twenty years of near stalemate, this should be a positive development.

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