Biotechnology, Bio-weapons and Science Diplomacy

Douglas Nascimento Santana*

Introduction

It is now possible to produce organic chemicals through biotechnology, as well as to synthesize biological molecules by chemical processes (Tucker 2010). The technical developments that allowed the approach of these two sciences are multiple: metabolic engineering, enzymatic engineering (biocatalysis), biopharming and traditional DNA-recombinant technology are examples of biotechnologies capable of producing organic molecules and chemicals substances; while DNA synthesis and semi-automatized peptide synthesis are examples of technologies for chemical synthesis of molecules with biological origin (Khosla 2014).

The technological convergence between chemistry and biology that underpins the current state of the art of biotechnology expands the range of products, services and solutions in the areas of health, agriculture and the environment, resulting in the promotion of economic development and improvements in the living standards of populations. An illustrative example of the economic and social implications of this technological convergence is the development of molecules similar to the polio virus through the genetic manipulation of the tobacco plant. The primary objective of the study is the production of vaccines, at a lower cost (Marsian et al, 2017).

. The difficulty in discerning the nature (whether chemical or biological) of these new agents provokes a need for institutional adjustments in the current systems of non-proliferation of weapons of mass destruction as well as the creation of new

* *Diplomat, Ministry of Foreign Affairs, Brazil.*

alternatives of international collaboration in the area (Trapp , 2014).

This article argues that the parameters of these regulations should start from the agenda of Science Diplomacy towards the agenda of Defense Diplomacy. Adjustments in the opposite direction can restrict access to essential technologies for various sectors of the economy, especially in developing countries, with no guarantees of additional security gains. At first, we will briefly present the *rationale* that has restricted the use by states of technological developments in chemistry and biology for non-peaceful purposes, in order to try to correctly evaluate risks, without alarms or negligence. Later , it will be argued that Science Diplomacy can contribute to biotechnology development and minimize risks.

New Advancements, Traditional Rationale

During World War I, the use of toxic gases resulting in a high number of deaths demonstrated a destructive potential that would bring chemical and biological weapons to be categorized as weapons of mass destruction. In the period between the First and the Second World War, recognizing the terror that this threat caused and the need to extend humanitarian protection in armed conflicts, states acceded to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, the Geneva Protocol of 1925 (Guillemin 2005).

Although it expressly prohibited the use of chemical and biological weapons, this convention was silent on the possibility of developing or acquiring them, so that some of its signatories, particularly the large industrial nations, set up robust government programs for the production of these "higher forms of killing "(Paxman and Harris , 2011). Taking into consideration the technical feasibility of producing these armaments, why were chemical and biological weapons not widely used in World War II and in subsequent inter-state wars? This question is important because it allows us to understand the rationality underlying the current reluctance to the use of these weapons by states.

Since the middle of the twentieth century, the development of large arsenals of chemical and biological weapons by major military powers, the inability of a state to defend itself against all the multiple types of toxins and pathogenic gases that can be produced by the enemy, and the permanent threat of retaliation with the same types of weapons inhibited - and have inhibited - the so called first strike. There are also technical limitations on the handling of these weapons in real combat situations. The impossibility of determining the necessary dose of the toxic agent to be sprayed and the difficulty to predict the wind flows that would spill over them would attribute an inconceivable logistical uncertainty to the military planning of a possible attack (Guillemin , 2005).

In addition to the imbalances among nations in their capacities to develop such weapons and the technical limitations mentioned above, the massive expression of public opinion, especially in democratic regimes, against attacks with lethal poisons had curbed belligerent impulses"(Paxman & Harris , 2011). Thus, it can be said that the decision on the use of chemical and biological weapons in inter-state wars is now, on the one side, between the certainty of violating international law and unacceptable behavior in terms of international public opinion and, on the other, doubts about military success of the attack and the type of retaliation to be suffered. As a result, decision of not using these weapons was found to be a better option.

The mastering of nuclear technology, whose use as a weapon of mass destruction would be more effective and with more predictable results, has definitively discouraged the use of chemical and biological weapons. Throughout the second half of the twentieth century, military powers gradually abandoned their offensive programs of chemical and biological technologies and promoted a deepening of norms and institutions that guarantee their use only for peaceful purposes (Guillemin 2005).

We argue that there is no reason to believe that the *rationale* underlying the future application by states of new technological developments in biology and chemistry is different from this historically settled *rationale*. Case-specific control measures can be an appropriate alternative to broad institutional changes and comprehensive interventions, even when the formers are well conducted under the rules of the Chapter VII of the United Nations Charter (SOSSAI , 2010). Historical experience from the nuclear regime further demonstrates that comprehensive restrictions can have the collateral effect of posing barriers to access to technology for peaceful purposes (Miller & Sagan 2009)..

Science Diplomacy: Offering Credible Alternatives

Science Diplomacy has been increasingly recognized as an important instrument for stabilizing relations between countries and reducing risks of direct conflicts. The technical knowledge and the apolitical language of science are capable of bringing erstwhile political enemies to the table of negotiation to solve current transnational problems.

The first contribution that Science Diplomacy could provide to the future international biotechnology agenda is related to the institutionalization of the regime of non-proliferation of weapons of mass destruction. With this objective in mind, specialists could systematically analyze the production of organic molecules by biological processes and the chemical synthesis of natural toxins, in order to help the surveillance work of the Chemical Weapons Convention (CWC) and the Biological Weapons Convention (BWC).

The normative and institutional system of CWC, what includes the Organization for the Prohibition of Chemical Weapons (OPCW), is considered exemplary in the area of disarmament and non-proliferation. It has succeeded in almost completely destroying the chemical weapons stockpiles of its 190 member states without creating additional obstacles to the technical and scientific progress of the chemical industry, which is aligned with the interests of developing countries (OPCW, 2008; OPCW, 2019b).

As BWC lacks a formal verification system, the burden of avoiding the production of lethal chemical agents by biotechnology and of monitoring chemical processes capable of synthesizing biological toxins would come under the CWC. This convention specifically provides for the types of industrial plants to be inspected by the OPCW. The current OPCW routines (products listed in Schedules I, II and III and OPCW inspections - production facilities of other chemicals), however, do not cover verification of the development and production of these compounds (OPCW, 2019a;Tucker , 2010).

In view of the need to create combined methods of verification within the BWC, including a declaration of activities by states, continuous monitoring and inspection of suspected plants, it is essential to guide the decision-making process by reliable scientific information (OPBW, 2019;Goldblat, 1997). At the BWC Review Conferences, the apolitical language of science may be crucial in avoiding the intensification of the already existing rivalries between Western Countries (WEOG) and the Non-Aligned Movement Countries (NAM) regarding a protocol for strengthening the institutional framework of the convention with verification mechanisms (Trapp, 2014).

The second contribution of Scientific Diplomacy can be in modeling the future agenda of biotechnology is related to the management of risks arising from the sharing of technical data by high-level laboratories and research centers, via specialized journals or through access to large online databases.

The publication of research results is fundamental for the maintenance of the peer-review process that has gradually improved the science since its origin. Considering the multiple potential applications of the recent advances in biotechnology, ensuring the peaceful use of information becomes part of the work of each researcher and each knowledge-producing institution. Updating the existing codes of conduct for the publication of scientific information is a crucial step to guarantee an appropriate flow of knowledge. For this objective, it is imperative that Science Diplomacy help negotiating internationally – in multilateral fora on the revision of these codes of conduct.

Furthermore, it is important that these codes could be guided by the premise that vital information for the synthesis, replication and inoculation of new agents must be kept confidential. Due to the operational nature of this information, this reservation does not compromise the evaluation of the testability and falsifiability of the theories and conclusions which derive from the original studies. An analogous system of selective information disclosure has been practiced in the field of quantum physics since the mid-twentieth century, with full success in preventing the proliferation of the capacity to produce nuclear artifacts by non-state agents (Miller & Sagan , 2009).

A final contribution of Science Diplomacy to the peaceful use of biotechnological innovations is to support the construction of an international framework for regulating the use of computer systems and robotics in experiments of molecular engineering. The convergence between scientific disciplines is even more evident here. To biology and chemistry, it is possible to add computing, robotics and nanotechnology to forge a complex of scientific knowledge production that uses the most advanced equipment and research inputs (Van Hecke et al., 2002). The limited number of international producers or suppliers of these inputs opens room for the regulation of access to them to be implemented through an international register that associates technological capacity with security risks. Similar risk-scaling system has long been used to manage the availability and commercialization of equipment that uses enriched uranium (Miller & Sagan 2009).

The tendency to theoretical and empirical convergence between chemistry and biology is a hegemonic view in the specialized scientific environment, constituting the so-called Chemical Biology. It is also possible to add informatics, robotics and nanotechnology to this complex of disciplines (Khosla , 2014; Van Hecke et al., 2002). As a result, since the beginning of the 21st century the international society has witnessed an exponential growth in the possibilities of biotechnology intervention in the reality of people. New drugs, prostheses, types of food, chemical and biological agricultural pesticides are traded and take part in daily lives of families, companies and governments (National Research Council , 2006).

Technology, as an instrument of practical application of scientific knowledge, cannot be aprioristically defined as beneficial or harmful to the population that develops it. The uses of technology are socially defined, in accordance to moral, ethical, religious and cultural values as well as philosophical conceptions (National Research Council , 2006). After the atrocities practiced with chemical weapons by both contending sides during World War I, a consensus was generated in international society, which remains strong and intense, that whatever technology could be developed, it should never be used for the purpose of mass killing. With new biotechnologies, this article argues that the judgment is not different. Therefore, it is vital that former institutions could be strengthened and new ones created when necessary, in order to ensure that biotechnology applications remain for peaceful purposes.

As stated above, the existence of the threat of non-peaceful use does not, however, justify the migration of the future international biotechnology agenda from the field of Scientific Diplomacy to the field of Defense and Security Diplomacy. Comprehensive restrictive measures in the research, development and commercialization stages of biotechnology can amplify barriers to the access of advanced equipment and research inputs, especially for developing countries that do not yet manufacture them, as well as to widen the technological gap between developed and developing countries.

If Defense and Security Diplomacy can have limitations in dealing with the innovations in the area of biotechnology, the discussion above allows the conclusion that Scientific Diplomacy has much to contribute, either in the technical underpinning of decisions in the context of non-proliferation regimes of chemical and biological weapons covered by the CWC and BWC, whether in the international covenants of codes of conduct for the dissemination of scientific information or even in the creation of an international framework for regulating the use of computer systems and robotics in experiments of molecular engineering.

Conclusion

Minimizing the risks of non-peaceful uses of new advances in biotechnology by collaboration outside the area of defense and security can also help to balance broader tensions in bilateral relations between countries; open new institutional and personal channels of communication; and increase mutual trust among nations. These are possible positive externalities brought by the Scientific Diplomacy, whose importance for international relations cannot be neglected. They have already emerged from negotiations involving, for example, climate change and pandemic control, so it is as possible as desirable that they could also emerge from the negotiations involving the future agenda of biotechnology.

At an organizational level – lower than the state scale –, it is also possible to envisage that efforts to build safer mechanisms for research, technological development and information sharing in the biotechnology realm can strengthen and internationalize the relationships between the institutions of the national systems of science, technology and innovation, such as universities, research laboratories, science academies and development agencies.

Endnote

1 In the context of the Convention for the Prohibition of the Biological Weapons (BWC), the negotiations are polarized by a political division between to unofficial regional groups that act as voting blocs: 1) Western European and Others Group (WEOG), composed by European countries, Canada, Australia, New Zealand, Turkey and Israel as members, and the United States as observer; 2) the Non-Aligned Movement (NAM), composed since 1961 by a variety of countries, such as Colombia, Cuba, Iran, India, Indonesia and other, that act against major blocs of power. For more information, see: United Nations Regional Groups of Member States (in: https://www.un.org/depts/DGACM/RegionalGroups.shtml) and Morphet, 2004

References

Goldblat., J. 1997. The Biological Weapons Convention: An Overview. International Review of the Red Cross Archive, v. 37, n. 318, p. 251-265,

Guillemin., J., 2005. Biological Weapons: from the invention of state-sponsored programs to contemporary bioterrorism. New York: Columbia University Press,

Khosla., C., 2014. The Convergence of Chemistry & Human Biology.: Daedalus, v. 143, n. 4, p. 43-48,

Morphet., S., 2004 . Multilateralism and the Non-Aligned Movement: what is the Global South doing and where is it going?. Global Governance, v. 10, n. 4, p. 517-537,

Marisain , J. *et. al* 2017 Plant-made polio type 3 stabilized VLPs—a candidate synthetic polio vaccine. Nature Communications, v. 8, n. 1, p. 245.

Miller., S., E., and Sagan.,S.,D.2009 Nuclear power without nuclear proliferation?. Daedalus, v. 138, n. 4, p. 7-18,

National Research Council 2006. *Globalization, biosecurity, and the future of the life sciences*. Washington, DC: National Academies Press,

OPBW, Organization for the Prohibition of Biological Weapons. 2019 Summary report of the ad hoc Group of Governmental Experts to Identify and Examine Potential Verification Measures from a scientific and technical standpoint. Available in: http://www.opbw.org/verex/docs/final_dec/verex%20final%20declaration.pdf. Access in: 7 January 2019.

OPCW, Organisation for the Prohibition of Chemical Weapons 2019 . Convergence of Chemistry and Biology: Report of the Scientific Advisory Board's Temporary Working Group. The Hague, The Netherlands: June, 2014. In: https://www.opcw.org/fileadmin/OPCW/SAB/en/TWG_Scientific_Advsiory_Group_Final_Report.pdf. Access in: 7 January 2019.

OPCW, Organisation for the Prohibition of Chemical Weapons. Genesis and Historical Development. In: https://www.opcw.org/chemical-weapons-convention/genesis-and-historical-development. Access in: 8 January 2019.

OPCW, Organisation for the Prohibition of Chemical Weapons. 2008 Report of the Scientific Advisory Board on Developments in Science and Technology. Note by the Director-General (RC-2/DG.1, dated 28 February 2008), 2008.

Paxman., J. & Harris., R., 2011 *A higher form of killing*. Manhattan: Random House.

Sossai., M. 2010 Drugs as weapons: disarmament treaties facing the advances in biochemistry and non-lethal weapons technology. Oxford University Press. *Journal of Conflict & Security Law*, v. 15, n. 1, p. 5-24.

Trapp. R. 2014. Convergence at the Intersection of Chemistry and Biology—Implications for the Regimes Prohibiting Chemical and Biological Weapons. *Biochemical Security 2030*. Policy Paper Series, no. 6.

Tucker, J.B. 2010. The convergence of biology and chemistry: Implications for arms control verification. *Bulletin of the Atomic Scientists*, v. 66, n. 6, p. 56-66.

Van Hecke, G.R. *et al.* 2002 An integration of chemistry, biology, and physics: the interdisciplinary laboratory. *J. Chem. Educ*, v. 79, n. 7, p. 837.