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Biotechnology and STI Diplomacy

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Introduction

The convergence of methods for producing scientific knowledge and creating new technologies is increasing among the fields of chemistry and biology, resulting in a newly shaped biotechnology. It is now possible to produce chemicals by using living beings, as well as to synthesize biological molecules through chemical processes (Tucker, 2010). The technical developments that has allowed the approach of these two sciences is manifold: metabolic engineering; enzymatic engineering (biocatalysis); biopharming; traditional DNA-recombinant technology; Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology; DNA synthesis and semi-automatized peptide synthesis; "omics" technologies, such as genomics, transcriptomics, epigenomics, immunology, proteomics, metabolomics, and others (Khosla, 2014; Ibrahim, Pasic & Yousef, 2016.).

This 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, fostering economic development and improvements in the living standards of populations. An illustrative example of how these technological convergences can spillover economic and social benefits is the development of molecules similar to the poliovirus through the genetic manipulation of the tobacco plant aiming at manufacturing vaccines at a lower cost (Marsian et al. 2017).

However, it might not be neglected as nuclear and ballistic missile technologies, biotechnology breakthroughs pose the risk of dual use, and must remain

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under severe scrutiny of international rules of the current systems of non-proliferation of weapons of mass destruction. The difficulty in discerning the nature (whether chemical or biological) of these new agents sparks doubts about what is the appropriate institutional framework of surveillance for each case, whether the Chemical Weapons Convention (CWC) system or the Biological Weapons Convention (BWC) system (Trapp, 2014).

This paper argues that some parameters for regulating innovations in the field of biotechnology can start at the agenda of Science, Technology and Innovation (STI) Diplomacy towards the agenda of Defense Diplomacy. Surveillance considering exclusively security preoccupations 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, this paper 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 presented how diplomats that work with STI Diplomacy can contribute to future biotechnology development by prioritising principles and alternatives that are commonly neglected in the political discussions focused on minimising risks of misuses of new technologies.

New Advancements and Traditional Practices

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 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 programmes 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 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 behaviour in terms of international public opinion and, on the other side, doubts about military success of the attack and the type of retaliation to be suffered. As a result, the decision not to use these weapons has been found to be the best 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. As a consequence, throughout the second half of the twentieth century, military powers gradually abandoned their offensive programmes 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 against dissident groups can be an appropriate alternative instead of comprehensive interventions against nations, even when the formers are well-conducted under the rules of the Chapter VII of the United Nations Charter (Sossai, 2010).

STI Diplomacy: Alternative Pathways

STI Diplomacy has been increasingly recognised as an important instrument for stabilising 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 help solving transnational problems, such as the natural resources quarrels involving Middle East nations or the aerospace dispute between the United States and the Soviet Union during the Cold War.

Despite this potential to help freezing warm international themes, STI Diplomacy is still far from the High Politics discussion, in the classical words of Joseph Nyer, such as that of mitigating the risks of the dual use of biotechnologies breakthroughs. Notwithstanding, this paper argues that a pro-active diplomatic stance towards pushing STI Diplomacy into major security issues could help tackling some problems of the future biotechnology agenda.

The first contribution that Science Diplomacy could provide to biotechnology would be to help deepening the institutionalisation of the regime of non-proliferation of weapons of mass destruction by strengthening the importance of scientific knowledge in the decision-making process of these systems. In order to improve the surveillance measures of the CWC and BWC, diplomats that work with science, technology and innovation shall make the necessary efforts to guarantee that technical reports of specialists that systematically analyze the production of organic molecules by biological processes and the chemical synthesis of natural toxins could prevail over the subjective opinions of diplomats that work in the political area of their chancellery.

The normative and institutional system of CWC, which 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).

Given 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[1] (Trapp, 2014).

The second contribution of STI Diplomacy is to help in modelling the future agenda of biotechnology which could be related to the management of risks arising from the sharing of technical data via specialized journals or through access to large online databases by high-level laboratories and research centers. 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 would be important that STI diplomats could consider the building or revision of these codes of conduct not a matter of private institutions relations but a part of their work to push forward national interests in many innovative areas, such as biotechnology. In this regard, they could lead the process of negotiating broad international agreements on scientific information sharing, a commonly neglected issue in political discussions between diplomats about non-proliferation.

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 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 STI diplomats to the peaceful use of biotechnological innovations is to support the construction of an international framework for technology control that encompasses computer systems, robotics and nanotechnology which are applied in the field of biotechnology. 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 large number of international producers and suppliers of these inputs sparks the alternative of implementing technology control through a broad and unified international register that associates technological capacity with security risks. A similar risk-scaling system has long been used to manage the availability and commercialisation of equipment that uses enriched uranium (Miller & Sagan, 2009).

Future Biotechnology Agenda

Technology, as an instrument of the 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 with moral, ethical, religious and cultural values as well as philosophical conceptions ((Balakrishnan, 2017; 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. Together, the CWC and BWC systems have offered a credible set of rules and institutions that have reinforced the peaceful use of chemical and biological breakthroughs for generations.

A new phenomenon has emerged in the last decade. The tendency to theoretical and empirical convergence between chemistry and biology is a hegemonic view in the specialised 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 the daily lives of families, companies and governments (National Research Council, 2006). Considering this, it would do no harm to think about reviewing and updating the normative framework of the system of non-proliferation of weapons of mass destruction in order to improve the surveillance over new biotechnologies.

Nevertheless, some principles must be kept in mind if the international community is to strengthen the CWC and BWC´s surveillance methods without undermining the economic and social potential of biotechnology breakthroughs. Comprehensive restrictive measures in the research, development and commercialisation 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. Furthermore, 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).

The aforementioned preoccupation is a hotspot at the STI Diplomacy agenda. However, STI Diplomacy has a minor role, if any, in the decision-making process of future changes in the non-proliferation regime. It is up to STI diplomats to demonstrate that an exclusive security perspective is limited in dealing with the innovations in the area of biotechnology. This battle must be fought inside chancelleries as much as in international fora. STI diplomats must engage in initiatives that present the potential of scientific knowledge to contribute to the technical underpinning of decisions in the non-proliferation regimes of chemical and biological weapons; that foster negotiations of international codes of conduct for the dissemination of scientific information; and that create an international framework for balanced and rational technology control of computer systems, robotics and nanotechnology applied in biotechnology experiments.

Conclusion

Minimising the risks of non-peaceful uses of new advances in biotechnology by collaboration coming from outside the area of defense and security can help balancing broader tensions in bilateral relations; open new institutional and personal channels of communication; and increase mutual trust among nations. These are possible positive externalities brought by STI Diplomacy, whose importance for international relations can no longer be neglected. These benefits 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.

Endnotes

1 In the context of the Convention for the Prohibition of the Biological Weapons (BWC), the negotiations are polarized by a political division between two 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

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