Introduction

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1. Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.

2. Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

Article 27, Universal Declaration of Human Rights (UDHR)

[Everyone has] the right (a) to take part in cultural life;

(b) to enjoy the benefits of scientific progress and its applications;

(c) to benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

Article 15 (1) International Covenant on Economic, Social and Cultural Rights (ICESCR)

The International Covenant on Economic, Social, and Cultural Rights (ICESCR) from 1966 turned the rights enshrined in the 1948 Universal Declaration of Human Rights (UDHR) into binding obligations under international law for ratifying states.[1] One of these rights is the right to enjoy the benefits of scientific progress and its applications, referred to here as the right to science. Both instruments mention the right to science alongside the rights to take part in cultural life and authors' rights. Together with the right to education, these three rights constitute the core of the so-called cultural rights and, ideally, interact to enable the flow of human creativity and understanding.[2] The drafters of the UDHR counted Articles 23 through 27 UDHR, outlining the four core cultural human rights, among the most fundamental and

[1] As a declaration, rather than a treaty or covenant, the UDHR originally bore no force of law but rather expressed an ideal standard held in common with and by nations around the world. Today, it is generally considered as reflecting customary law, which is binding upon all states.

[2] See Helle Porsdam, *The Transforming Power of Cultural Rights: A Promising Law and Humanities Approach* (Cambridge University Press, 2019).

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argued that these rights "aim at the realization of the right to the full development of one's person."[3]

Due to its classification as a cultural right, the vastness of its subject matter, and its physical location near the end of both the UDHR and ICESCR, the Right to Science (RtS) has long been overlooked. Indeed, when we conducted a systematic review of the extant literature with colleagues, we found a total of only seventy-eight publications.[4] As the American Association for the Advancement of Science has stated, "governments have largely ignored their Article 15 obligations and neither the human rights nor the scientific communities have brought their skills and influential voices to bear on the promotion and application of this right in practice."[5]

This neglect is surprising given both the relevance of science to the fulfilment of other human rights and the current political climate of hostility to facts, scientists, and experts. In a world where Harvard University libraries, the wealthiest in the world, have to declare insufficient funds to afford journal subscriptions; where President Putin expresses the opinion that "whoever becomes the leader in [artifical intelligence and quantum computing] will rule the world";[6] where the Chinese state jails the first scientist to edit human embryos using CRISPR/Cas9; where democratically elected politicians preface their comments with the reminder that they are "not a scientist,"[7] yet speedily proceed to call into question the most basic of scientific tenets – in such a world, the fact that enjoyment of the benefits of scientific progress and its applications has been recognized as a human right is of great practical, legal, and normative relevance.

Fact-based knowledge and evidence no longer exert the rational pull they once did. At the same time, progress in science becomes ever more arcane, specialized, and difficult to comprehend. Moreover, people are increasingly afraid of the "dual use" of emerging technologies involving for example artificial intelligence or human genetic modification. Digital exclusion and a lack of scientific literacy furthermore add to the distrust in science. Public access to scientific information primarily involves the digital media. Today, this essentially means making digital versions of new research publicly available by means of, for example, open-access journals, repositories, and mandatory open-access policies. Especially the latter policies ensure that publicly funded research is shared

[3] Johannes Morsink, *The Universal Declaration of Human Rights: Origins, Drafting, and Intent* (University of Pennsylvania Press, 1999), p. 212.

[4] S. Porsdam Mann, V. J. Bradley, M. F. Chou, G. Church, M. Mann, C. Mitchell, Y. Donders, and H. Porsdam, "On the Human Right to Enjoy the Benefits of Science and Its Applications" (2018) *Proceedings of the National Academy of Science* 115(43), pp. 10820–10823; updated in S. Porsdam Mann, Y. Donders, and H. Porsdam, "Sleeping Beauty: the Human Right to Science." (2020) 42(2) *Human Rights Quarterly* 332–356.

[5] AAAS Scientific Responsibility, Human Rights, and Law Program website, quoted in Porsdam Mann, Bradley, Chou, Church, Mann, Mitchell, Donders, and Porsdam, p. 10820.

[6] R. Gigova, "Who Vladimir Putin Thinks Will Rule the World," CNN Online, https://edition.cnn.com/2017/09/01/world/putin-artificial-intelligence-will-rule-world/index.html.

[7] This tendency is true of several and diverse global leaders and is wonderfully laid out in D. Levitan, *Not a Scientist: How Politicians Mistake, Misrepresent, and Utterly Mangle Science* (Norton & Company, 2017).

across the world. Nevertheless, digital divides in computer or cell phone use and in access to the internet exist "for reasons of income, education, gender and geographic location."[8]

Even in areas of the world where people do have access to scientific knowledge on as well as off the internet, there is a lack of scientific literacy. Many simply do not know enough science to be able to distinguish proper from fake or pseudoscience. "Not only can people find it difficult to grasp new knowledge (largely due to the digital divide), but they also lack the necessary critical tools to question this knowledge (in terms of source and content) and assess its reliability."[9] The resulting disbelief in science and science-based reasoning constitutes a problem for democratic societies, which crucially rely on rational and evidence-based decision-making.

The right to science adds a normative and judicial dimension to issues at the intersection of science and society. The right to science thus provides a perfect tool not only for presenting evidence-based knowledge, but also for highlighting the complexity and uncertainty of the questions raised, thereby reflecting the fact that science and its applications are part of the cause as well as the cure. Yet despite its potential for defending science and the freedom to think, question, and share scientific ideas, the right to science has not received the attention it deserves. It has remained an inefficient legal norm, which neither informs major policy and governance issues, nor gives guidance to practicing scientists and the public.

The historical neglect of the right to science has in part been due to the difficulty in interpreting its implications, both normative and practical.[10] In April 2020, during the COVID-19 pandemic, the Committee on Economic, Social and Cultural Rights (CECSR), the independent UN body monitoring the implementation of the ICESCR, published General Comment No. 25 on Science, a document to help governments and courts understand the duties imposed on States Parties by those parts of Article 15 ICESCR that especially concern science.[11] Like other General Comments, this document is vested with considerable authority and will heavily influence how international law in areas relevant to science and scientists will be developed and interpreted.

Several of the contributors to this volume participated as experts on the General Day of Discussion on the new General Comment on Science, which took place on October 9, 2018 at the UN Human Rights Office of the High Commissioner in

[8] Report of the UN Special Rapporteur in the field of cultural rights, A/HRC/20/26, para. 37.

[9] Cécile Petitgand, Catherine Régis, and Jean-Louis Denis, "Is Science a Human Right? Implementing the Principle of Participatory, Equitable, and Universally Accessible Science" (Ottawa, Canada: the Canadian Commission for UNESCO's Idealab, 2019), p. 6.

[10] See e.g. Porsdam Mann, Bradley, Chou, Church, Mann, Mitchell, Donders, and Porsdam, pp. 10820–10823.

[11] CESCR, General comment No. 25 (2020) on science and economic, social and cultural rights, UN Doc. E/C.12/GC/25, April 30, 2020.

Geneva.[12] Mikel Mancisidor de la Fuente, member of the CESCR and coauthor of the General Comment on Science, is among the contributors to the present volume. This book is therefore the first to contain the perspective of the primary author of the new General Comment. Moreover, it is the first to contain the reactions and reflections upon the General Comment by the leading academic experts and human and science rights advocates out there, as nearly all fifteen chapters have been adapted to fit the content and release of the General Comment.

The Right to Science: Then and Now reflects the most current and leading perspectives on the right to science. Its ambition is to elucidate both the theory and the practical significance of the right. The fifteen contributions touch on several challenging conceptual questions. Among these are the issues of dual use science and how we might ensure that potentially harmful impacts of scientific and technological developments are minimized or avoided. Embodying "principles that are intended to inform the conduct of science,"

> at its core, Article 15 requires that science be used as an instrument for human benefit, and that the process of doing scientific research and the development of applications from that science be consistent with fundamental human rights principles such as nondiscrimination and equal treatment, participation and transparency in decision-making, and free and informed consent to participation in research.[13]

Article 15 also touches upon complicated and important issues of access to and participation in science, science policy, and priority setting within science. Together with the larger cultural rights and ICESCR framework, the Article 15 rights present a helpful instrument of analysis for issues that are already pertinent but will only increase in importance over time. These include access to, ownership, and dissemination of, data, knowledge, methods, and the affordances and applications thereof; as well as the role of international cooperation, human dignity, and other human rights in relation to science and its products. Backed up by both international law and public morality, Article 15 provides a unique and powerful perspective on these intricate issues.

Unless it is legally defined, guidance for full implementation of the right to science may never be established.[14] When it comes to the significance of this and other cultural rights, moreover, we need to look not only at the level of each individual person or group; we also need to explore the importance of the right to science at the societal level. From a personal perspective, the main issue is the possibility that the right to science gives for each individual and/or group to develop

[12] See www.ohchr.org/EN/HRBodies/CESCR/Pages/Discussion2018.aspx.

[13] AAAS, "Right to Science: FAQs" – available at www.aaas.org/programs/scientific-responsibility-human-rights-law/resources/faqs.

[14] See e.g. Jessica M. Wyndham and Margaret Weigers Vitullo , "Define the Human Right to Science," Editorial, *Science*, Nov. 30, 2018, Vol. 362, Issue 6418, pp. 975 DOI: 10.1126/science.aaw1467: http://science.sciencemag.org/content/362/6418/975.

and acquire knowledge – and thereby to get a better life. But the general welfare of democratic society, too, depends on an educated and open-minded citizenry. For the framers of the UDHR, an enlightened and well-informed citizenry constituted the best defense against hatred and bigotry – and for democracy. It also formed the basis for human rights education, and what later became known as education for democratic citizenship.

When Farida Shaheed became the first mandate holder as UN Special Rapporteur in the field of cultural rights in 2009, she was met by skepticism on the part of many states. This skepticism most of all had to do with the uncertainty surrounding the exact nature of cultural rights – were these rights a distinct area of human rights, were they universal like other human rights and not relativistic? Part of the problem, she relates in her reflections on the significance and challenges of the mandate, "stemmed from the paucity of previous work on cultural rights, reflected in the frequent comment prior to my mandate, that cultural rights were a generally underdeveloped area in comparison to other human rights."[15] This situation has since been remedied somewhat. On cultural rights in general, the last few years have seen the publication of various monographs and edited volumes.[16]

More specifically to the right to science, Aurora Plomer published *Patents, Human Rights and Access to Science* in 2015.[17] This, along with Richard Pierre Claude's *Science in the Service of Human Rights* (2002), represents the most thorough book-length treatments to date.[18] Anna Maria Andersen Nawrot's *The Utopian Human Right to Science and Culture* (2014) addresses the topic from a postmodernist perspective, while Philipp Aerni explores the intersection between economic rights and the right to science in his *Entrepreneurial Rights as Human Rights* (2015).[19]

[15] Farida Shaheed, "The United Nations Cultural Rights Mandate: Reflections on the Significance and Challenges," in Lucky Belder and Helle Porsdam (eds.), *Negotiating Cultural Rights: Issues at Stake, Challenges and Recommendations* (Cheltenham: Edward Elgar, 2017), p. 22.

[16] See e.g. Helaine Silverman and D. Fairchild Ruggles, *Cultural Heritage and Human Rights* (Berlin: Springer, 2007); Yvonne Donders and Vladimir Volodin (eds.), *Human Rights in Education, Science and Culture* (Burlington, VT and Ashgate, UK: UNESCO and Ashgate, 2007); Francesco Francioni and Martin Scheinin, *Cultural Human Rights* (Leiden, NLD: Martinus Nijhoff, 2008); James A. R. Nafziger, Robert Kirkwood Paterson, and Alison Dundes Renteln (eds.), *Cultural Law: International, Comparative, and Indigenous* (Cambridge: Cambridge University Press, 2010); Olivier de Schutter (ed.), *Economic, Social and Cultural Rights as Human Rights* (Cheltenham: Edward Elgar, 2013); Federico Lenzerini, *The Culturalization of Human Rights Law* (Oxford: Oxford University Press, 2014) Ana F. Vrdoljak, *The Cultural Dimension of Human Rights* (Oxford: Oxford University Press, 2014); Lucky Belder and Helle Porsdam (eds.), *Negotiating Cultural Rights: Issues at Stake, Challenges and Recommendations* (Cheltenham: Edward Elgar, 2017); and Helle Porsdam, *The Transforming Power of Cultural Rights: A Promising Law and Humanities Approach* (Cambridge: Cambridge University Press, 2019).

[17] Aurora Plomer, *Patents, Human Rights and Access to Science* (Cheltenham: Edward Elgar, 2015).

[18] Richard Pierre Claude, *Science in the Service of Human Rights* (Philadelphia, PA: University of Pennsylvania Press, 2002).

[19] Anna Maria Andersen Nawrot, *The Utopian Human Right to Science and Culture: Toward the Philosophy of Excendence in the Postmodern Society* (London: Routledge, 2014); Philipp Aerni,

STRUCTURE AND CHAPTERS

The Right to Science: Then and Now is an interdisciplinary endeavor. When it comes to the setting of the right to science as well as other cultural and human rights – the way in which they are formulated in international treaties and domestic and international law, and applied in practice in national constitutional and legal systems – law is obviously a key discipline. Yet it is not the only one; a purely legal approach fails to take into account the ethical, historical, political, economic, anthropological, as well as the scientific, technical, and health-related dimensions. These are just as important and it is only by integrating data, tools, perspectives, and theories across faculties and disciplines that we can begin to get a sense of the full right to science picture.

The volume is divided into three parts. Following the editors' Introduction to the volume, Part I concerns the history of the right to science: how this right was developed, and the lessons we may learn from this. This first part consists of five chapters. In the first chapter, "The Dawning of a Right: Science and the Universal Declaration of Human Rights (1941–1948)," **Mikel Mancisidor** explores how and under what circumstances the right to science entered the UDHR, and what the *travaux préparatoires*[20] of the Declaration may tell us about why those who drafted the Declaration chose these precise words – what they intended to say, and what they avoided saying.[21] The Universal Declaration of Human Rights started out as a succession of working drafts over one and a half years. The first draft was prepared by the Canadian jurist John Peters Humphrey, who had been appointed the first Director of the United Nations Division of Human Rights. This first draft, which is a very complete list of the rights that had been recorded in other declarations and reference texts, was then rearranged and converted into a more consistent declaration by the French jurist René Cassin. That draft subsequently had to pass the drafting Committee and the sessions of the Human Rights Commission before being approved by the ECOSOC and finally, on December 10, 1948, by the General Assembly in session at the Palais Chaillot in Paris, resulting in the Universal Declaration of Human Rights that we know today.

Entrepreneurial Rights as Human Rights: Why Economic Rights Must Include the Human Right to Science and the Freedom to Grow Through Innovation (Cambridge: Banson, 2015).

[20] Johannes Morsink, *The Universal Declaration of Human Rights: Origins, Drafting and Intent* (Philadelphia PA: University of Pennsylvania Press, 1999); Mary Ann Glendon, A *World Made New: Eleanor Roosevelt and the Universal Declaration of Human Rights* (New York: Random House, 2001); and William A. Schabas : *The Universal Declaration of Human Rights. The travaux préparatoires* (New York: Cambridge University Press, 2013).

[21] As established by article 32 of the 1969 Vienna Convention on the Law of Treaties, "the preparatory work of the treaty and the circumstances of its conclusion" are not principle resources for interpreting the texts as regards their application, but are "supplementary means of interpretation" which can be used to find out more about this right.

Humphrey's first draft already included a right to science in the same article as culture and arts. According to René Cassin,[22] the article was included per request from several cultural organizations, including UNESCO,[23] which was represented at this time before the Commission on Human Rights by Jacques L. Havet. Why did the drafters not include any mention of the purposes of science? What was UNESCO's role in those debates? What were the impacts of the Nuremberg Trial? And how were the two thematic elements, the right to take part in science and the right to enjoy the benefits of scientific progress and its applications, introduced in the final version?

In Chapter 2, "The Origins of the Right to Science: The American Declaration on the Rights and Duties of Man," **Cesare P. R. Romano** begins by noting the distinction between the "right to benefit from advancements in science and technology" (i.e. the Right to Science) and the so-called "rights of science" (e.g. rights to academic freedom, to conduct research, to reap the fruits of one's own inventions etc.). Romano proceeds to discuss the roots of these two sets of rights. The roots of the rights of science run deep, all the way to Bacon and Galileo, and intertwine with other more well-known rights, such as the right to education and freedom of expression. The roots of the Right to Science are relatively more recent and can be traced to the work of the Inter-American (I-A) Juridical Committee, the expert body that drafted the American Declaration of Human Rights. This chapter tells the story of the debates between the members of the I-A Committee on the right to science, the various wordings they considered, and the influences and considerations that shaped their choices. Finally, it explains how and why the wording of Article XIII of the American declaration morphed into Article 27 of the Universal Declaration and, later, Article 15.1.b, 15.2–4 of the ICESCR.

Aurora Plomer's chapter (Chapter 3), "IP Rights and Human Rights: What History Tells Us and Why it Matters," investigates how human rights have been a critical counterweight to the social and economic costs of the global extension of intellectual property (IP) rights. The Universal Declaration of Human Rights provides the foundational values which are at the heart of this critique. Plomer retraces the origins and normative foundations of the rights of authors and inventors in the Universal Declaration of Human Rights. She argues against recent scholarship which questions the relevance of human rights to current debates about IP rights, shows how this scholarship conflates IP rights with human rights, and demonstrates why human rights were never intended to be equated with IP rights. Resetting the history of human rights and IP rights reveals why human rights

[22] Morsink, p. 218.

[23] On the UNESCO's intellectual contribution to the drafting of the Universal Declaration, see UNESCO/PHS/3(rev) Paris, July 25, 1948, with contributions by J, Maritain, M. Gandhi, E. H. Carr, B. Croce, R. P. Teilhard de Chardin, A. Huxley and two specific papers on scientific matters: "Rights and Duties Concerning Creative Expression, in particular in Science", by J. M. Burgers¸ and "Science and the Rights of Man", by W. A. Noyes.

continue to have a meaningful role to play in protecting public goods and addressing the grave injustices caused by the global extension of IP rights today.

The title of **Ivan Lind Christensen's** chapter (Chapter 4) is "Fostering a Love of Truth: Conceptions of Science in UNESCO's Early Years." Apart from publishing *Recommendation on the Status of Scientific Researchers* and the subsequent *Recommendation on Science and Scientific Research* (1974 and 2017, respectively), UNESCO has been a significant agent in international science cooperation since 1945. The 'S'cience in UNESCO was, however, a last-minute addition, which was closely tied to the beginning of the nuclear age, and the creation of the previously unthinkable, annihilative power of the nuclear bomb. The science department of UNESCO was thus created at a time when science did not only promise endless, modern progress to the broader public as well as to many politicians, but also threatened world destruction. In the following decades, the onset of the Cold War posed its own challenges to the idealized norms of science as proposed by Robert K. Merton in 1942 (universalism, communality, disinterestedness, and organized skepticism), as well as to the ideas of international science cooperation in general. In this chapter, Christensen traces the different ideas of science as they were articulated within UNESCO, thereby illustrating what the organization itself understood by the concept of science and its relations to concepts of modernity, progress, and development.

Roberto Andorno's chapter (Chapter 5), "The Right to Science and the Evolution of Scientific Integrity," presents the history of the development, in the United States as well as in Europe, of ethical concerns in science. Science is one of the highest expressions of human thought and makes a crucial contribution to the well-being and progress of society. This is why the right to freely conduct science is expressly protected by international human rights law (Article 15, paragraph 3, ICESCR). As the object of this right is "science," activities conducted by scientists are protected by this right insofar as they satisfy the requirements set up by ethical guidelines and professional standards. Practices that involve fabrication or falsification of data and plagiarism contradict the very essence of science, as they encompass acts of deception of the scientific community and society. Over the past few decades, awareness has grown about the importance of adhering to ethical standards in the conduct of science. Scientific misconduct became the subject of significant public attention beginning in the 1980s, which led to public statements and guidelines by academic and funding agencies, as well as to procedures for dealing with allegations of misconduct in science.

In Part II, the right to science now, that is to say at the present time, is explored in five chapters. Chapter 6, "On the Right to Science As a Cultural Human Right," is an essay written by former UN Special Rapporteur in the field of cultural rights, **Farida Shaheed**, and **Andrew Mazibrada**, based on an interview with Shaheed conducted by the editors. Among the topics covered are the challenges Shaheed faced in developing the broad normative contents for the right of science for the

Human Rights Council; why this right should be embedded within cultural rights at all – a question that has itself engendered significant debate – and how the thread connecting the apparently disparate fields of culture and science is in fact human creativity, which lies at the heart of cultural rights. The chapter underlines the importance of adopting a "public good" approach to knowledge innovation and diffusion, illustrating the critical relevance of the right to science today by reference to a few selected issues. It concludes with the need to have robust discussions involving all parties, including in particular the private sector, whose voices have historically been nearly or entirely missing from human rights discussions.

In Chapter 7, "Mainstreaming Science and Human Rights in UNESCO," **Yvonne Donders** and **Konstantinos Tararas** explore the unique mandate UNESCO has in the UN system to "contribute to peace and security by promoting collaboration among the nations through education, science and culture in order to further universal respect for justice, for the rule of law and for the human rights and fundamental freedoms." (Article 1 of UNESCO's Constitution). The advancement of human rights is an explicit goal of UNESCO, that is; and science is one of the fields through which UNESCO ought pursue this goal. Indeed, UNESCO has adopted legal instruments and has developed programs and activities in the field of science and human rights, most notably in the fields of bioethics and ethics of science. Donders and Tararas discuss several ways, including instruments and policies, in which UNESCO has worked on human rights in relation to science, and on science in relation to human rights. They attempt to bring to the fore the core approaches underpinning these efforts; to highlight the evolution in the Organization's thinking; and to show the extent to which these are aligned to and promote the advancement of the right to enjoy the benefits of scientific progress as included in human rights instruments, in particular the dimensions of scientific freedom, protection against harm, benefit sharing and international cooperation.

"Considering the Right to Enjoy the Benefits of Scientific Progress and Its Applications As a Cultural Right: A Change in Perspective," is the title of Chapter 8. **Mylène Bidault** presents a set of criteria allowing us to consider science as being part of culture, and to rethink the right to benefit from scientific progress and its applications as an emanation and specification of the right to participate in cultural life. Such an approach deeply influences our understanding of the "right to science," now commonly mentioned in academic and human rights circles. It may be time, though, Bidault suggests, also to refer to a right to "participate in scientific life," meaning the right of everyone to access and contribute to the development of science, as well as to practice their scientific and critical spirit in everyday life. This does not mean that everyone ought suddenly to become a scientific researcher nor that we all should be regarded as such, but rather that everyone may be a researcher in their own spheres of interest, using and refining knowledge for the sake of their own personal development and aspirations.

Chapter 9 concerns "Implications of the Right to Science for People with Disabilities." In her contribution, **Valerie J. Bradley** explores the unique and powerful importance of the right to science for people with intellectual, physical and mental health disabilities. The human rights of people with disabilities articulated in the Convention on the Rights of People with Disabilities (CRPD) (2006) directly connect to the principles and aspirations of the right to science. As noted in the 2014 meeting of the American Association for the Advancement of Science on *Disability Rights and Accessing the Benefits of Scientific Progress and Its Applications*, access to science and technology can have both a positive and negative impact on the rights of people with disabilities. Bradley begins with a review of the human rights of people with disabilities both in the CRPD and as articulated and reinforced in public policy and judicial rulings. Those rights, which have specific affinities to the right to science, include the ability to live independently, to be employed, to enjoy health and well-being, to receive adequate education, to have access to habilitation and rehabilitation, and to be free from degrading treatment. The intersection of the right to science and its applications and the realization – or abridgement – of these rights are explored. Further, the unique vulnerability of people with disabilities as subjects of scientific research and experimentation, including a history of exploitation and the application of now discredited interventions, are described, just as the barriers, physical as well as educational, to people with disabilities as students and practitioners of science are examined. Finally, for people with disabilities, access to technology holds the promise of more independent functioning, a reexamination of the construct of disability, and increased community participation.

Stjepan Orešković's and **Sebastian Porsdam Mann's** chapter (Chapter 10), "Science in the times of SARS-CoV-2," explores the applicability of the right to science to the 2020 coronavirus pandemic. The disproportionate impact of the virus on minorities and the socioeconomically disadvantaged highlights the importance of the fundamental human rights principles of equality, nondiscrimination, and international cooperation. The rise of government surveillance powers occasioned in some countries due to the need for contact tracing and public health measures give rise to dual use concerns. The woefully inadequate preventive measures taken before the pandemic illustrate the need for States Parties to progressively realize their obligations under the right to science before disaster strikes. Yet the current, global response to the pandemic also represents an unprecedented degree of international collaboration, and the evidence-based responses of some individual nations have saved countless lives.

Orešković and Porsdam Mann draw a distinction between "fast" and "slow" science. Whereas the latter involves rigorous and laborious adherence to the scientific method, the former represents the reality that much scientific work faces time pressures which at times force shortcuts. The distinction can be seen to operate in contemporary research into the coronavirus pandemic: whereas the development of

vaccines and treatments usually requires years of meticulous laboratory work and several more years of clinical testing, the many millions suffering from the disease need a treatment *now*. However, by taking too many safeguards off the treatment discovery and testing pipelines, or by refusing to act in accordance with scientific advice, governments risk sacrificing the public's trust not only in the government's scientific bona fides but in the scientific process itself. This is a heavy price to pay, argue Orešković and Porsdam Mann, and point to evidence indicating that the success of Germany and Japan in combating COVID-19 can be traced to public trust in science and government, as well as scientifically informed and respectful national leadership.

The five chapters of Part III look at various ways in which the right to science is disseminated, implemented, and put into practice. **Ranga Yogeshwar,** in Chapter 11, "Fight the Fear with the Facts!," investigates current shifts in the grammar of communication of social networks and media, some of which contribute to the avalanche of fake news and alternative facts which we are currently experiencing. This shift begins to dissolve the base of enlightenment and questions science as such. How do we deal with complexity and how do we communicate science in a world with easy-to-use interfaces? Social networks act like fire accelerators, for their characteristic feature is the reversal of the flow of direction of media: they lend every citizen a voice and a great deal of steam now flows out of this valve. Former mass media now become the media of the masses, and this networked flow of news runs unembellished, unedited, and superficially free of charge. Even within science and among scientists, we encounter similar patterns with novel publishing models. Some questionable open access publications seem likewise to profit by, and therefore contribute to, the dissemination of fake science.

This is why science has to act on its own in a sound and professional way, Yogeshwar argues. Little is known in this field and we could develop a science of communicating facts based on knowledge rather than instinct. How do we present statistical data to the wider population in a more understandable way? How do we communicate risk without inducing fear? What is the best graphic approach to give people a sense of relevance? How do we display complexity? According to Article 15(2) ICESCR, the dissemination of science is a constitutive element of the right to science. Our aim should be to strengthen the language of enlightenment, and to fuel the open and critical dialogue that is the foundation of every civilized society.

Chapter 12, "The Right to Science – From Principle to Practice and the role of National Science Academies," by **Jessica M. Wyndham**, **Margaret Weigers Vitullo, Rebecca Everly, Teresa M. Stoepler,** and **Nathaniel Weisenberg**, examines points of convergence and disconnect between scientists across the globe and States party to the ICESCR regarding the key benefits of science and the key obligations of states. Without widespread recognition among scientists and the public and without implementation at the level of governments, the right to science has little meaning in practice. Wyndham et al. introduce the idea that national academies of science

within States Parties may have a central role to play in the implementation of this right, serving as an intermediary to distill and frame key priorities regarding the right to science within their national context, and providing locally relevant and feasible recommendations for how their government might fulfill its obligations under Article 15.

The chapter draws from three stages of empirical inquiry into what the right to science means from the perspectives of scientists, engineers, and health professionals; action required to realize the right in practice; as well as barriers to its implementation. The first stage involved seventeen disciplinary-specific focus groups of US-based scientists which informed the development of a new conceptual framework for understanding "access" in the context of the right to science. This contributed to an expansive vision for the benefits of science as being both tangible and intangible. The second stage involved a global questionnaire of scientists, engineers, and health professionals to identify regional variations particularly in the actions necessary to ensure realization of the right to science, as well as targeted interviews of public health professionals about the value of the right in practice. The third stage is informed by qualitative research carried out specifically for this chapter. This empirical work involved interviewing representatives of science academies in countries that are a party to the ICESCR to determine how the right to science could be used as a tool of policy and advocacy to address core concerns at the intersection of science and society, for example, access to quality STEM education, health care, and/or climate change.

Together with **Sebastian Porsdam Mann, Yvonne Donders** and **Helle Porsdam** look at the interpretation of the right to science and its normative implications in Chapter 13, "The Right to Science in Practice: A Proposed Test in Four Stages." The Right to Science adds an important legal and ethical dimension to fundamental issues in science. The authors propose a four-step framework, derived from Articles 2, 4, and 15 of the International Covenant on Economic, Social and Cultural Rights, which may be used as a practical means of testing policy choices and implications against the obligations derived from the right to science. The first step consists in identifying whether a given policy, product, or aspect of science constitutes a "benefit of scientific progress" or "its applications." Where this is the case, Article 15(1)(b) establishes a prima facie right to the aspect of science in question. However, the RtS is not absolute, and the second step of the framework involves testing the prima facie right against competing rights claims and the Article 2 and 4 limitation criteria. These establish that limitations to the right must be (1) determined by law; (2) compatible with the nature of the ICESCR rights; (3) invoked solely for the purpose of promoting the general welfare in a democratic society; (4) and consistent with fundamental human rights principles of inclusion, participation, nondiscrimination, and dignity.

The third step specifies the obligations of States towards ensuring the respect, protection and fulfilment of the right in light of the duties imposed by Article 2 to

"undertake to take steps, individually and through international assistance and co-operation, especially economic and technical, to the maximum of [States'] available resources, with a view to achieving progressively the full realization of the rights recognized in the present Covenant by all appropriate means, including particularly the adoption of legislative measures." Finally, the fourth step aims, using other associated human rights principles and further Articles of relevant treaties, to delineate the steps needed to achieve these aims in practice by identifying the policy option which is both (1) most likely to maximize benefits and (2) consistent with the limits and obligations imposed by the right to science and fundamental human rights principles.

In Chapter 14, **Mike Frick** and **Gisa Dang** investigate "The Right to Science: A Practical Tool for Advancing Global Health Equity and Promoting the Human Rights of People with Tuberculosis." Tuberculosis (TB) has killed more people than any other infectious disease in human history and remains the leading cause of death from a single infectious agent globally. The deadly persistence of TB reflects decades of underinvestment in research and development and insufficient efforts by governments (i.e. duty bearers) to make the benefits of scientific progress and its applications available to all people with and at risk of TB. The prevailing orientation of biomedical innovation – defined by a maximalist approach to intellectual property protection – does not prioritize the health of poor and marginalized communities which bear the greatest burden of TB. Nor do many governments' health laws and policies keep up with scientific progress, resulting in outdated TB programs with negative outcomes for the health and human rights of individuals with TB.

Frick and Dang examine how the Treatment Action Group (TAG) has applied the right to science as the primary frame for analysis, activism, and community mobilization aimed at promoting TB research and ensuring equitable access to its benefits. They first illustrate how TB stands as a paradigmatic example of the consequences of state inattention to the development, diffusion, and conservation of science. Then, they describe how TAG has applied right to science principles and concepts in pursuit of three overarching questions in the context of TB: (1) What does access mean under the right? (2) What does participation under the right look like in practice? (3) How can advocates hold governments accountable for upholding their obligations under the right?

Finally, in Chapter 15, "A Proposal for Indicators of the Human Right to Science," **Andrea Boggio** and **Brian Gran** discuss how indicators may be used to monitor realization of the human right to science articulated in Article 15 ICESCR. Measuring the extent of the gap between universally acknowledged standards and implementation efforts of national governments contributes to the realization of the human right to science for different countries at different times. Indicators are widely used to monitor how well states live up to the standards necessary for the advancement of human rights. Following a review of relevant literature on human rights indicators, Boggio and Gran propose a definition of the normative content of

the human right to science and identify indicators which can be used to measure the realization of the right. They discuss several challenges and limitations of their approach yet ultimately argue for the utility of indicators. Such indicators can be used to (1) facilitate monitoring of compliance with Article 15 of the Covenant on Economic, Social and Cultural Rights by UN bodies as well as human rights advocates; (2) refine the essential attributes of the human right to science, which are still not well defined; and (3) assist national governments in implementing policies that contribute to the realization of the human right to science.

The Right to Science: Then and Now ends with an "Epilogue" by **Christine Mitchell.**

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