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Anticipation under the human right to science: concepts, stakes and specificities

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ABSTRACT

Recent years have seen the emergence of dual-use technologies and, more generally, of scientific practices that are potentially beneficial to humanity, but that may also have an irreversible impact on human beings. In those circumstances, the issue of the adequate anticipation not only of the risks (of harm) of science, but also of its (opportunities for) benefits has become more pressing. One framework from which States may derive duties and responsibilities to anticipate both those 'risks' and 'benefits' of science is the human right to enjoy the benefits of scientific progress and to participate in that progress (in short, the 'human right to science'). Not only indeed does that right include everyone's right to participate in the scientific enterprise and its organisation and to access to and enjoy the benefits of scientific progress, but it also includes the right to be protected against the adverse effects of science. Interestingly, while some duties to anticipate grounded in the human right to science have been briefly mentioned in recent interpretations of the right, their specific content, scope and bearers have not yet been addressed in depth. Remedying this gap is the aim of this special issue and of its eight original contributions.

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Introduction

Recent years have seen the increasing emergence of dual-use technologies and, more generally, of scientific practices that may have an irreversible impact on human beings, but that are also, and inextricably so, potentially beneficial to humanity and the future of human life. It suffices here to think of new techniques such as AI, genetic editing and, more broadly, of geo- and bio-engineering. In those circumstances, the issue of the adequate anticipation not only of the risks (of harm) of science, but also of its (opportunities for) benefits has become more pressing than ever.

One framework from which States and, arguably, other domestic and international (mostly public, but also arguably private) institutions may derive duties and/or responsibilities to anticipate both the 'risks' and 'benefits' of science is the human right to

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participate in and to enjoy the benefits of scientific progress and its applications (in short, the 'human right to science' or HRS), as it is guaranteed by Article 15(1)(b) International Covenant on Economic, Social and Cultural Rights (ICESCR).[1] Not only indeed does that right include everyone's right to participate in the scientific enterprise and its organisation and to access to and enjoy the benefits of scientific progress, but it also includes the right to be protected against the adverse effects of science. Even if the latter and third prong of the right to science remains difficult to grasp, it has since been endorsed repeatedly, albeit in different terms, by various United Nations (UN) reports, statements and comments.[2]

Interestingly, however, those anticipation duties' and responsibilities' specific content, scope and bearers have not yet been addressed in depth by scholars and practitioners of the right. Nor has the tension between preventing the risks of science and promoting its benefits, created by their unique combination in the duties correlative to the HRS, been clarified to date. While some duties and responsibilities to anticipate grounded in the HRS are mentioned by, for instance, the UN Committee on Economic, Social and Cultural Rights' (CESCR) in its General Comment No. 25 of 2020 on Science and Economic, Social and Cultural Rights, it has not been so nominally, and only in passing and without any sustained systematic attention.[3] Moreover, the notions of '(opportunities for) benefit' and '(risks of) harm' borrowed from the instrumentalist lexicon of anticipation, but also, more generally, the transposition of the 'costs versus benefits' balancing framework itself inside the human rights framework need to be interpreted and assessed critically. This is even more the case when the human right at stake is the human right to science whose *raison d'être* is precisely, as I will argue, to protect against the instrumentalisation of science.

Such is the point of this special issue and of its eight original contributions. Their aim is to specify the content, scope and bearers of the various duties and responsibilities to anticipate diligently the adverse effects caused by emerging technologies and other scientific innovations (including, albeit non-exclusively, 'precaution' and 'prevention' duties), but also to promote those technologies and innovations when beneficial to humanity. The articles in this special issue focus first and foremost on the HRS, but comparisons with various anticipation duties and responsibilities arising under other human rights (e.g. other social and cultural rights) and under other international law regimes (e.g. international environmental law and international biomedical law) and their limits are also explored.

After a first section devoted to the *concepts* underlying this special issue (1.), this introduction unpacks the *stakes* of the anticipation of the adverse effects of science in general (2.), before spelling out what could be the *specificities* of anticipation under the HRS (3.). A fourth and final section is dedicated to the articulation of the special issue and provides an *overview* of its contents (4.).

1. The concepts: 'anticipation' under the 'human right to science'

This special issue revolves around two key concepts that need defining more specifically before one can understand how the human right to science can provide a fruitful framework in which to anchor the anticipation of both the beneficial and adverse effects of science: the concepts of 'human right to science' (1.1.) and 'anticipation' (1.2.).

1.1. The human right to science

The last fifteen years have revealed a renewed academic interest in a long neglected human right and provision: Article15(1)(b) ICESCR's human right to science.[4]

The project to reinvigorate the right has now also spread across various UN bodies. The most important documents to that effect are, besides the UN General Assembly's 1975 Declaration[5] and the UN Educational, Scientific and Cultural Organization (UNESCO)'s 1974/2017 Recommendation,[6] 1999 and 2005 Declarations[7] and 2009 Venice Statement:[8] the UN Special Rapporteur on Cultural Rights' 2012 and 2014 reports on the right[9] and, most recently, the CESCR's 2020 General Comment No. 25 on Science and Economic, Social and Cultural Rights.[10]

The difficulty, however, is that State practice has itself never caught up with the HRS. By way of consequence, UN bodies' interpretations have not yet been in a position to consolidate a minimal consensus based on an evanescent State practice.[11] If this is to change, it is important to understand what happened to the HRS in the immediate post-war period and what prevented it from giving rise to State practice.

As I have argued elsewhere,[12] the HRS is best understood as the 'human right to participate in science', by reference to the first declaration of the right in Article 27(1) Universal Declaration of Human Rights (UDHR).[13] The idea back then, indeed, was that science should be guaranteed as a human right to an independent participatory good, a good requiring a strong institutional and normative structure. Amidst the cold war, and with the progressive individualisation of science, the human right to participate in science quickly lost its participatory dimension. As one may observe in its reframing in the guarantee of Article 15(1)(b) ICESCR,[14] the right has indeed become little more than a passive right to enjoy scientific benefits and a mere redistributive afterthought. Hence the short but inadequate denomination that is still widely used today when referring to the right: the human right *to* science. No wonder then that the right, thereby stripped of any social and participatory teeth, quickly became dormant.[15] More accurately said, it was put to sleep.[16]

Today, in our attempts at reinvigorating the right, we should aim at reviving the post-war consensus on the public and participatory good of science.[17] It is at this condition only that the human right to science could re-acquire some teeth in international and domestic law and play a role – both domestically and internationally – in the institutional and normative structure of science. The time for that (re-)institutionalisation of science is ripe.[18] It suffices to consider the contemporary individualisation, instrumentalisation and privatisation of science, but also certain scientists' counter-reaction akin to what happened every time science was instrumentalised in the course of history, that is, their tendency to 'self-validate'.[19] From pre-war institutionalism to post-war individualism, and back, we seem to have come full circle – yet again, as Robert Merton would argue.

1.2. Anticipation

In a nutshell, the point of anticipation, turned into an individual and institutional imperative, is to foresee and control, as much as possible, the potential harms to come and to do so by identifying the risks of such harms, managing and containing them, and even accounting for not doing so.

Understood in this way, anticipation has become an ubiquitous dimension of modern society. Ulrich Beck's 'risk society'[20] and its related 'vigilance society' avatar have indeed turned into what may be described as the 'anticipation society'.[21] The law itself, including international law, has been deeply affected by those developments. It has also contributed to the consolidation of the anticipation concern in return. Hence, for instance, a more future-oriented approach to 'time' in the law, as confirmed by the emergence in recent years of new legal concepts such as 'intergenerational' equity or 'sustainability'. One should also mention the consolidation recently of duties and principles of 'prevention' and 'precaution' and the related renaissance of the standard of 'due diligence'.[22]

It is beyond the scope of this introduction to address the legal concept of anticipation in full and the different articles in the issue will shed a different light on that concept. It suffices for our purpose to present the two principles and corresponding duties of precaution and prevention that have come to epitomise anticipation duties in international law, together with the standard of due diligence that qualifies both duties.[23] Those two principles and this standard constitute what one may refer to as the 'anticipation triptych' under contemporary international law. Anticipation may indeed be conceived, albeit non-exhaustively so, as a tri-dimensional concern, composed of three panels: precaution on the left, due diligence in the middle and prevention on the right.

The first principle, and corresponding duty, of *precaution* requires the adoption of measures of avoidance or, at least, of mitigation and of reduction of risks of serious and irreversible harm, and this even when, under the current state of scientific knowledge, the occurrence of that harm is only probable and remains uncertain. The duty of precaution's relationship to the second principle, and corresponding duty, of *prevention* is progressive and evolves with the degree of scientific knowledge. Indeed, once the occurence of harm goes from being uncertain to becoming certain scientifically, the principle of precaution becomes one of prevention and a duty of prevention arises.[24]

The duties of precaution and prevention are duties of conduct by opposition to duties of result. The duty-bearers are not expected to guarantee the absence of harm, indeed, but only to do their best to avoid the harm or, at least, mitigate and reduce the risk of harm in the concrete circumstances. This is what is meant by the term 'best effort obligations'. The assessment of what amounts to the duty-bearer's best effort in each case is of the essence. It is at this point that the third, and central, panel of the anticipation triptych, i.e. the standard of *due diligence*, enters the scene. *Qua* standard of conduct, due diligence is grafted upon and qualifies the duties of precaution and prevention: it requires reasonable (or due) care (or diligence) in precaution or prevention. In other words, the duties of precaution or prevention are only breached in case of unreasonable or undue negligence.

More specifically, the standard of due diligence itself is breached if two conditions are fulfilled: (i) the foreseeability of the harm, which implies that the duty-bearer knew ('real knowledge') or should have known ('constructed knowledge') about the risk of harm; and (ii) the ability to prevent or protect against it, which entails that the duty-bearer had the capacity to do something about that risk.[25] The foreseeability and ability conditions are often qualified as 'reasonable' to the extent that they only amount to what a reasonable person (here, the 'well-organised State') could foresee and was able to do. Moreover, and this is constitutive of an upper threshold of due diligence, the two conditions are adapted to the specific conditions of the duty-bearer and need to be contextualised in each case.[26] In international human rights law, finally, and this is constitutive of a minimal threshold

of due diligence, the kind of risks duty-bearers should be diligent about are usually limited to risks of 'real' and 'immediate' harm.[27]

2. The stakes: anticipating the adverse effects of science generally

There are many actual threats to address under the HRS. One may think here of threats to academic freedom, open access to science or indigenous knowledge, for instance. Given the pace of contemporary science, however, many of the threats we should be concerned about here and now are also emerging threats or even threats to come.

Of course, the concern over the future adverse effects of science and the need to anticipate them adequately is an *ancient one*. It led to various declarations and statements by the UN General Assembly as early as 1975.[28] The concern actually dates back to the 1940s when it was first expressed in the negotiations of the UDHR.[29] Since then, it has regularly been confirmed by UNESCO[30] and the CESCR.[31]

Back then, concerns over the adverse effects of science and the need to anticipate them as much as possible were triggered by three distinct realisations: the understanding that there could be a disjunction in practice between 'moral-social progress' and 'scientific progress';[32] a reaction to the development of 'dual-use' technology that could both benefit and harm humanity at the same time (as exemplified by nuclear energy), and, in some cases, a reaction to the 'abuse' or 'misuse' of science (as exemplified by racist biology);[33] and, last but not least, the critique of the political and legal instrumentalisation of science (as exemplified by various forms of 'scientific socialism' or the adoption of 'biological laws').[34]

Besides its long pedigree, anticipation of the adverse effects of science is also a *renewed* and *pressing* concern today. This has to do with important changes in the temporal and spatial framework of science, but also with changes in the relationship between law and science and the growing confusion between the so-called 'laws of science' and the law *tout court*.

Starting with the temporal framework of science, the pace of science has changed drastically in the last twenty years, as epitomised by fast-developing, high-risk science and technology, high-risk science that also comes with high uncertainty. The result is that new and emerging science actually merge, and so do anticipation and protection. One should also mention the changing impact of science over time as new technologies typically have more lasting consequences (including on future generations), and sometimes even irreversible ones. Think again of AI, genetic editing, but also of geo- and bio-engineering. Turning to the new spatial framework of science, secondly, science is now conducted on a global scale, thereby potentially globalising its adverse effects and the concern about them. Another related change pertains to the privatisation of science in a research-driven economy. Privatised science makes research less transparent and predictable, thereby fuelling the concern for its adverse effects.

As a matter of fact, the combination of those temporal and spatial developments has created important disparities in scientific advancement and different paces of scientific development and hence led to a certain degree of scientific polychrony. That polychrony makes the anticipation of the adverse effects of science particularly challenging.

Finally, a third development, which is related to the first two, is the emergence of what one may refer to as political and legal 'scientism'. While the instrumentalisation of

science by law and politics used to be the problem, and still is to some degree, it has contributed to entrenching a reverse problem: the increasing role of science in the law[35] and, by extension, the pivotal role now played by science in the law pertaining to anticipation, including anticipation of the adverse effects of science.[36]

This is true of all regimes of domestic and international law, and especially in criminal law and in environmental law. The latest example, but not the least and one that should worry us given the fundamental role of human rights in the legal order, is the emergence of a form of scientific fundamentalism in international human rights law itself. According to this reading, the foundations of our human rights *qua* rights of human persons should be found in the latter's biology or genomics, and their interpretations should be aligned with the latest development of scientific knowledge on those issues. Think, for instance, of the increasing, albeit largely unnoticed, reference to the term human 'species' in international human rights law, instead of earlier references to the human 'person'.[37]

Importantly, the current stakes of anticipation under the HRS do not only pertain to the kind of high and lasting impact of modern science and its fast-developing pace. They also relate to the future of international human rights law itself.

Indeed, anticipation is a topic human rights lawyers should concern themselves more actively with if they do not want the doctrine of anticipation duties and due diligence merely to mirror the instrumental solutions identified in other international law regimes, such as international environmental law or international biomedical law. This is a risk that is actually being accentuated by the growing number of cases of climate change litigation before human rights courts and bodies.[38] What the lawyers and judges may resort to when arguing and deciding those cases, including the complex issues of diligent precaution and prevention duties they raise, are indeed ready-made solutions from other regimes of international law which they merely propose to transpose into human rights law. Instead, one may hope that the specificities of anticipation duties arising under the HRS contribute to stirring a deeper discussion on anticipation under (international) human rights law.[39] The time has come to turn to those specificities.

3. The specificities: anticipating the beneficial and adverse effects of science under the HRS

If the concern for the anticipation of the adverse effects of science has long been with us and gained in urgency recently, the HRS presents specificities for those anticipation duties and responsibilities that need to be unpacked systematically here. The first subsection addresses the main specificity of the HRS in terms of anticipation (3.1.). Subsection two explores three additional characteristics of the HRS for anticipation purposes (3.2.), while sub-section three identifies two of its potential contributions that are still untapped and need to be further explored (3.3.).

3.1. The main specificity of the HRS in terms of anticipation

As alluded to earlier, the concept of anticipation is not unique to the HRS. Instead, anticipation duties and responsibilities pertaining to the risk of harm triggered by science are already well covered under international law. It is especially the case under international environmental law[40] and international biomedical law.[41]

Importantly, however, anticipation duties and responsibilities also arise under international human rights law and have been specified in that regime as well.[42] Actually, those duties have been the focus of most references to the duties to anticipate the adverse effects of science to date, and this both by UN bodies and scholars.[43] In those cases, anticipation of the adverse effects of science occurs through limits or *restrictions* to the HRS that may be justified in case of conflict with other human rights. This may take place in case of conflict between the HRS and, for instance, freedom of research, and other human rights such as, for example, the right to life, the right to health or the right to a healthy environment. In those cases, the anticipation duties and responsibilities arise under the latter rights, and not under the HRS itself. The HRS may then be restricted on that basis.

The specific anticipation duties that arise under the HRS are very different from the anticipation duties arising under other human rights, however. They do not amount to external limits to the HRS, but arise under that right itself; their objects are *objects* of the HRS. Accordingly, the main specificity of anticipation duties under the HRS is that they are not instrumental to the protection of other human rights, but are inherent to the protection of the HRS itself. The risk of harm at stake indeed does not pertain to harm to another interest and right such as life, health or privacy – although it may, of course, also do so –, but primarily to harm to the good of science itself and hence to one of the interests protected by the HRS.[44]

Of course, conflicts of rights and hence conflicts between the anticipatory duty (be it precautionary or preventive) under the HRS and other duties grounded in the same right may arise.[45] One may think here of a conflict between the right to be protected against the discriminatory effects of certain scientific experiments and the freedom of scientists to conduct those experiments. The resolution of such conflicts does, however, take place within the ambit of the right itself,[46] and this is what makes anticipation duties under the HRS so specific, as I will explain now.

3.2. Three further characteristics of the HRS in terms of anticipation

There are three additional specific characteristics of the anticipation duties that arise under the HRS by comparison to the duties to anticipate the adverse effects of science that arise under other human rights.

A first specificity of the HRS relates to the fact that the right is a *dualist right*: it protects at least two complementary interests, namely, the promotion of science's positive effects and the protection against its negative effects.[47] The first universal declaration of the human right to participate in science in 1948 was indeed as much a recognition of the existence of a fundamental and equal interest of all human beings in a certain kind of science, as it was a recognition of the vulnerability of that interest and of its need of protection against other kinds of science.[48]

Accordingly, anticipation duties under the HRS are both duties to identify and to promote the beneficial aspects of science, on the one hand, and duties to prevent and to protect against the adverse effects of science, on the other.[49] This means that, by contrast to what is the case of anticipation of the adverse effects of science under other human rights, anticipation under the HRS is not only negative and harm-oriented, but it is both positive and negative at the same time. What matters then is the balance

between the potential beneficial and adverse effects of science when specifying the content of the HRS and that of the corresponding anticipatory duties. Again, this may of course lead to conflicts of rights and duties under the HRS, and hence to specifying conflicting anticipatory duties within the HRS itself.

A second interesting feature of the HRS for anticipation purposes pertains to the right's *participatory* dimension. The right indeed protects science as a public good[50] that is also a participatory one, and hence, as I have argued elsewhere, the right protects both individual and collective interests in participating in science.[51] This is true of all three dimensions of the HRS mentioned in the introduction: the right to participate in the scientific enterprise and its organisation *stricto sensu*, of course, but also the right to access to and to enjoy the benefits of scientific progress and the right to be protected against the adverse effects of science.

In turn, the participatory dimension of the HRS implies organising equal public participation in order to anticipate the effects of science together. This includes equal participation in the information, deliberation and decision over issues of anticipation of both the beneficial and adverse effects of science. As examples, one may mention the United Kingdom's or Australia's 'citizen juries on genome editing'[52] or, more generally, Switzerland's regular popular referenda or initiatives pertaining to research bans and moratoria, two types of participatory experiences which one may emulate elsewhere on a domestic, regional or universal plane. The participatory dimension of the HRS also requires securing enough transparency on all scientific questions, and hence more overall predictability in science and better anticipation.[53]

A third specific, and related, feature of the HRS for anticipation purposes is its *communal* dimension. The HRS does not only protect a public good and a participatory one, but also a communal one, as I have argued elsewhere. Science indeed is a kind of public good that is not only in the collective interest or right, but also amounts to a common or communal responsibility of all.[54]

The communal dimension of the HRS has two implications for the duties and responsibilities[55] to anticipate the adverse effects of science.

Domestically, first, this implies that the burden of the *responsibility* of anticipation should not only lie with the public institutional duty-bearers of the right, such as States, but also with all the members of the epistemic communities active in the scientific practice.[56] This does include the scientists, but also all of us. The communal dimension of the HRS therefore precludes leaving the responsibility of anticipation solely in the hands of the duty-bearing public authorities. However, it also, and even more importantly, precludes leaving that responsibility only in the hands of scientists, for instance in the name of expertise and of scientific complexity of the risks at stake. As a result, the legal and institutional framework for scientific anticipation under the HRS should clearly be public in the first place, but also encourage and organise further scientific self-regulation of issues of anticipation. As I have argued elsewhere, this may occur along the lines of a new form of 'social' law, law that is neither private nor public.[57] One may refer to that new body of social law as 'science law' or law pertaining to science.

Internationally, secondly, the HRS' communal dimension implies that the burden of the responsibility of anticipation should not only lie with individual States. It is rather a *collective* responsibility that should give rise to collective duties of States held together by States, but also to collective responsibilities held together by all other institutions and

subjects.[58] The importance of those collective duties and responsibilities for the human right to participate in science may actually explain the separate reference to international cooperation in Article 15(4) ICESCR itself.[59] If the proposed argument is correct, however, international 'cooperation' in the anticipation of the adverse effects of science is not only a recommendation to provide bilateral aid, but also amounts to a duty of multilateral cooperation and international institution-building.[60]

Importantly, there are at least two gaps in the kind of anticipation duties one could specify under the HRS. They need to be addressed in the context of the right's reinvigoration processes. The first one pertains to the need for more intergenerational anticipation. This is no easy task in the absence of intergenerational rights in international human rights law unlike what is the case in international environmental law or international biomedical law.[61] It may, however, take the place of responsibilities to anticipate, albeit non-directed ones and ones that do not therefore correspond to actual human rights of future generations. The second gap concerns the lack of institutional framework for scientific anticipation, especially internationally. This is an important blind spot of the HRS and one that needs to be addressed urgently.[62] Some of the high-risk and high-uncertainty science addressed in this special issue is such that it can only properly be restricted through international law and institutions.

3.3. Two additional contributions of the HRS to anticipation

There are two further opportunities to seize under the HRS for the future of the duties of anticipation of the adverse effects of science. They could help not only develop anticipation duties that are specific to the adverse effects of science, but also, more generally, weigh on and hopefully redirect the current debate about the content of anticipation duties under international human rights law in general.

Sadly, however, those opportunities were missed by the CESCR in its General Comment No. 25. The latter's treatment of anticipation duties and responsibilities is not only cursory and unsystematic, but it also brings together different threads from the international law of anticipation developed outside international human rights law. It does so without any concern for their justification in international human rights law or for their coherence once those different pieces are brought together.

First of all, the HRS is relevant to the future of anticipation of the adverse effects of science to the extent that it may help stall the process of quantification and proceduralisation of anticipation and the *instrumental* cost-benefit approach to the corresponding duties that usually comes with it.

The approach to anticipation duties currently prevalent in international biomedical law and, as of late, in international human rights law, is indeed instrumental or consequentialist.[63] It relies on a 'cost and benefit' approach to harm and conceives the risks of harm as something to 'manage' in a 'maximisation' of benefits and a 'minimisation' of risks exercise.[64] Regrettably, it is also the approach that was chosen by the CESCR to conceptualise the anticipation duties arising under the HRS in its General Comment No. 25.[65]

One may criticise this prevailing approach in two respects. First, instead of treating human rights and interests as ends in themselves, this approach treats them as means one may quantify, balance with others and then maximise. Thereby, it contradicts the primary justification of human rights as a form of protection against the majority.[66]

Secondly, applying such a quantitative balancing test to the anticipatory assessment of the beneficial and adverse effects of a given scientific development entrenches the already predominantly instrumental approach to science, whereas we should instead be working out how to protect science against that very kind of understanding of science. After all, this was the point of the independent human rights guarantee of the inherent value of science in 1948. Instead, the prevalent quantitative approach to anticipation of the adverse effects of science encourages the commodification of science into a set of end-products rather than approaching it as a never-ending cultural process of creation.[67]

The second potential contribution of the HRS that has not been sufficiently understood and explored so far is that it may assist us in escaping anticipatory technoscience and the self-validating *scientific* approach to anticipation duties.

As mentioned before, current duties of precaution and prevention under international law, as specified in international environmental law and international biomedical law,[68] but also lately in international human rights law, rely on a test of 'certainty' and 'foreseeability' of harm based on the current state of scientific knowledge. The same applies to the standard of due diligence where the reasonableness test is increasingly replaced by an 'impact assessment' exercise[69] that is proceduralised and technicised.[70] It is, of course, easy to understand why this may sound like an attractive move to many: it proceduralises and technicises complex normative assessments, thereby allegedly 'objectifying' or 'universalising' through science what would otherwise look 'subjective' or even 'parochial' to most.

Regrettably, this is precisely the kind of approach adopted by the CESCR in its General Comment No. 25.[71] Its definition of the precautionary principle is borrowed from the one developed by UNESCO in 2015.[72] What the CESCR fails to grasp, however, is that that definition was specified outside of an international human rights framework, on the one hand, and not specifically for the anticipation of the adverse effects of science, on the other. Transposed without adaptation into anticipation duties arising under the HRS, this principle is difficult to apply and interpret further. Not only does it bring in, without any explanation, the principle of intergenerational equity and a potentially conflicting concern for the environment, but it also defines the 'acceptability of the harm' by reference to the 'consideration of the human rights of those who are affected'. It thereby turns the latter rights and consideration for them into external and independent points of reference, while it is precisely the content of the affected people's right to science and the adequate consideration for that right that one is trying to establish when specifying those anticipation duties. This confirms once again that the kind of anticipation duties the CESCR seems to have in mind are in fact duties arising under other human rights and restricting the HRS, rather than anticipation duties grounded in the HRS itself.

More generally, what this kind of reductive scientific understanding of the international law of anticipation fails to understand is the value of legal reasoning and of reason giving in circumstances of pervasive and persistent disagreement about what it is reasonable and diligent to prevent or promote. It also ignores the value of contextualising the universal when interpreting indeterminate normative notions such as reasonable care, proportionality, dignity or equality differently in different contexts.[73]

Last but not least, applying an approach based on scientific predictability to the anticipation of the beneficial and adverse effects of science itself is clearly circular. It bases the

normative assessment of the potential effects of science on a scientific assessment, i.e. that of scientific certainty. Not only does this assume the value-neutrality of science in circumstances of scientific disagreement, but it also encourages new research to provide more certainty about the risks, thereby locking in the deployment of the high-risk science at stake. All this contributes to turning 'scientific anticipation' into little more than an 'anticipation science'. It actually leads us straight back into the kind of scientific 'self-validation' criticised by Robert Merton[74] more than eighty years ago. Yet again, science (or a certain predominant form of science, at least) is in a position to determine its own ends and value. What is new this time, however, is that it may even be in a position to use the law to do so, and not the least of legal guarantees but the most fundamental of all: a human rights guarantee.

This is a serious concern. Indeed, going down this path risks undermining the whole purpose of the independent guarantee of science as an inherent participatory good under international human rights law. Of all international lawyers, international human rights lawyers should be the ones resisting complicity in this endeavour. The cuckoo is already in the nest.

4. Overview of the special issue

This special issue entails eight original contributions written for the occasion. It is useful to briefly go over the articulation of those different contributions and to provide an overview of their respective content.

In his opening historical article "Codifying the human right to science," William Schabas argues that anticipation of the adverse effects of science was an early concern of the drafters. The human right to science is set out in the UDHR and the ICESCR. The two texts, which were adopted consecutively, are similar but not identical. The *travaux préparatoires* indicate debate about whether the right was essentially about the freedoms of scientists or about the purposes of science, including concern about abuse. UNESCO's contribution to the UDHR was insignificant, but it had considerable influence on the text of the ICESCR. In 1950 and 1951, UNESCO issued important and influential expert statements challenging 'scientific' arguments of racial supremacists, confirming in practice its own understanding of the direction that science should take.

Moving the debate about anticipation away from the Global North's conception of science, Ro Hill's article "Anticipatory co-governance for human rights to sciences across knowledge systems" argues that the interface between Indigenous and Western knowledge systems highlights the existence of diverse sciences, each with its own history, contexts and processes for validation, and with relevance to the HRS. The lens of intersectional universality helps identify how Indigenous peoples differ in important ways that affect the HRS, including through: (1) holding unique connections to territories, distinct cultures, worldviews and knowledge systems; (2) experiencing dispossession of their lands, territories and resources leading to great disadvantage in socio-economic status; (3) bearing a disproportionately high share of the negative impacts of colonial scientific practices that breach human rights; and (4) utilising Indigenous governance systems based on customary institutions for decision-making. Human rights law requires that these institutions operate in ways that are consistent with principles of non-

discrimination. From this recognition of difference and sameness, the author argues that diligent anticipation of scientific risk needs to be based on recognition and support from States for the institutions that govern Indigenous sciences, on redress and reparation by relevant scientific organisations in relation to the negative impacts of colonial scientific practices and on capacity-building to overcome inequitable distribution of resources and power that results in the marginalisation of Indigenous people. Most importantly, anticipatory co-governance with Indigenous peoples at both national and international levels can empower Indigenous agency and provide a fertile ground for future thinking that will diligently anticipate risks and benefits of science and scientific progress.

In their article "Look before you leap: states' prevention and anticipation duties under the right to science," Yvonne Donders and Monika Plozza argue that States have an obligation to prevent harm and to anticipate the risks of harm of scientific progress and its applications. These obligations are derived from the right to be protected against the harmful effects of scientific progress and its applications, a dimension of the HRS. The duties to prevent harm are well established in existing international instruments, while the duty to anticipate the risks of harm remains obscure. The precautionary principle and due diligence can provide guidance on when and under what circumstances State obligations to anticipate risks of harm exist. Both concepts involve a necessity and proportionality test, which is also inherent to limitations under international human rights law. The prevention or anticipation of risks of harm of scientific progress and its applications may stand in conflict with other human rights or, in the context of the right to science proper, with the right to benefit from scientific progress and its applications or scientific freedom. In such cases, limitations on one right might be required to protect another, whereby the different interests protected under the HRS need to be properly balanced when undertaking limitations.

Camila Perruso's article "Anticipation under the human right to science and under other social and cultural rights" takes a second look at the issues of the content and scope of anticipation duties under the human right to science, albeit this time from a different angle: she adopts a comparative human rights law approach to compare anticipation under the HRS with the corresponding practice of other social and cultural rights. In her article, she explores how the right to science can benefit from the anticipatory obligations and mechanisms related to anticipation under those other rights. She argues, on the one hand, for the extension of some of the obligations of prevention, precaution and due diligence developed for other social and cultural rights to the HRS. She further identifies mechanisms capable of addressing the anticipatory, institutional dimension required to implement the HRS. Her contribution explores, on the other hand, how mechanisms such as indicators and human rights impact assessments, that have been developed and considered useful in the framework of other social and cultural rights, could also play a role in the implementation of the anticipatory aspects of the HRS.

The special issue then turns to a comparison with two other regimes of international law where anticipation duties pertaining to science are more widespread: international biomedical law and international environmental law. Two articles address those two regimes by comparison to the HRS and hence partly respond to one another.

In her article "Anticipatory duties under the human right to science and international biomedical law," Rumiana Yotova assesses the interplay between international human rights law and international biomedical law as two specialised regimes within

international law. The focus lies specifically on the anticipatory duties arising under the human right to benefit from science and its applications, on the one side, and under international biomedical law, on the other. International biomedical law instruments adopt a human rights-based approach to the regulation of biology and medicine, so one of the questions is whether the anticipatory duties in biomedical law are indeed a specific application of the corresponding duties in international human rights law, modified, expanded and elaborated further to better address the distinctive subject-matter, namely, the interface between the individual and science and technology in a medical context. Or should the anticipatory duties in international biomedical law draw from international environmental law and/or general international law? The main question that the article addresses concerns the precise scope and content of the anticipatory duties under international biomedical law and their relationship to human rights.

Anna-Maria Hubert's twin article "Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology" explores whether the integration of human rights approaches, in particular the HRS in Article 15(1)(b) ICESCR, potentially offers a basis for improving existing approaches in international environmental law by widening the basis for democratic input and oversight in various decisions involving environmental science and its applications. It incorporates a case study relating to the international regulation of marine geo-engineering under the 1996 Protocol (London Protocol) to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention). The analysis focuses on how the harms and benefits of marine geo-engineering research are conceived in the London Protocol amendment, as well as on the norms and processes that have been adopted to address them. These same issues are then examined under the HRS, focusing on the recent interpretation of the right by the CESCR in its General Comment No. 25. It seeks to show in a particular case how the different areas of international environmental law and international human rights law both bring to bear different objectives, norms and processes in how they treat issues of environmental science and technology. It also examines the potential benefits of a more integrated approach to regulating emerging applications, and some of the challenges that arise in attempting this.

In her article "Anticipation under the human right to science (HRS): sketching the public institutional framework. The example of scientific responses to the appearance of SARS-CoV-2," Amrei Müller turns to the institutional dimensions of anticipation under the human right to science. In her article, she sketches the domestic and international institutional framework that States shall set up to implement their anticipatory duties flowing from the HRS and, at the same time, that enables international institutions to comply with their anticipatory responsibilities deriving from the HRS. The example of the scientific response to the appearance of SARS-CoV-2 in late 2019 is used to concretise the proposed institutional structure, including by highlighting the shortcomings of the current framework.

With the same institutional focus, this special issue closes with Helle Porsdam and Sebastian Porsdam Mann's article "Anticipation and diplomacy (with)in science: activating the right to science for science diplomacy." In their contribution, the authors argue that a hitherto underappreciated aspect of science diplomacy – diplomacy (with)in science – has significant potential to complement the anticipatory approaches to

science discussed in the issue by furthering the same goals: addressing the negative impacts of scientific and technological developments and facilitating their benefits. The authors relate the concept of diplomacy (with)in science to the normative framework of the right to science under international human rights law and develop and motivate it further by illustrating two potential areas for its application.

Notes

1. International Covenant on Economic, Social and Cultural Rights, New York, 16 December 1966, *United Nations Treaty Series*, vol. 993, p. 3.
2. See e.g. UNESCO, *Venice Statement on the Rights to Enjoy the Benefits of Scientific Progress and its Applications (art. 15 (1) (b) ICESCR)*, July 17, 2009, https://www.aaas.org/sites/default/files/VeniceStatement_July2009.pdf, §13(a)(b), §13(c) ('protection *from abuse and adverse effects of science and its applications*') (emphasis added), §16(c) ('monitor the potential *harmful effects of science and technology*') (emphasis added); UN Human Rights Council (HRC), *Report of the Special Rapporteur in the field of cultural rights, Ms Farida Shaheed, on the 'Right to Enjoy the Benefits of Scientific Progress and its Applications'*, UN Doc. A/HRC/20/26 (May 12, 2012), https://www.ohchr.org/en/special-procedures/sr-cultural-rights/right-benefit-scientific-progress-and-its-applications, §9 et seq., §43, §74(h) ('provide opportunities for all to make informed decisions after considering both the possible improvements and potentially *harmful side effects or dangerous usages of scientific advances*') (emphasis added), §74(m) ('protect all individuals against *any harmful effects of the misuse of scientific and technological developments*') (emphasis added). See also, albeit less specifically, UN Committee on Economic, Social and Cultural Rights (CESCR), *Guidelines on Treaty-Specific Documents to be Submitted by States Parties under Articles 16 and 17 of the International Covenant on Economic, Social and Cultural Rights*, UN Doc. E/C.12/2008/2 (March 24, 2009), https://undocs.org/en/E/C.12/2008/2, §70; CESCR General Comment No. 25, *Science and economic, social and cultural rights (art. 15(1)(b), (2), (3) and (4))*, UN Doc. E/C.12/GC/25 (April 30, 2020), https://undocs.org/E/C.12/GC/25, §6, §11, §75; CESCR General Comment No. 17, *The right of everyone to benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he or she is the author (art. 15 (1) (c) ICESCR)*, UN Doc. E/C.12/GC/17 (January 12, 2006), https://undocs.org/E/C.12/GC/17, §35. See also Audrey R. Chapman, 'Towards an Understanding of the Right to Enjoy the Benefits of Scientific Progress and its Applications', *Journal of Human Rights* 8, no. 1 (2009): 1–36; William A. Schabas, 'Looking Back: How the Founders Considered Science and Progress in Their Relation to Human Rights', *European Journal of Human Rights*, Special issue on the Human Right to Science, 4 (2015): 504–18.
3. Especially CESCR General Comment No. 25, §53, §56–7, §71, §72–6.
4. See e.g. Samantha Besson, 'The "Human Right to Science" *qua* Right to Participate in Science: The Participatory Good of Science and Its Human Rights Dimensions', *International Journal of Human Rights* 2023: 1–32; Andrea Boggio, 'The Right to Participate In and Enjoy the Benefits of Scientific Progress and Its Applications: A Conceptual Map', *New York International Law Review* 34, no. 2 (2021): 43–77; Helle Porsdam and Sebastian Porsdam Mann, eds., *The Right to Science: Then and Now* (Cambridge: Cambridge University Press, 2021); Rumiana Yotova and Bartha M. Knoppers, 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing', *European Journal of International Law* 31, no. 2 (2020): 665–91; Sebastian Porsdam Mann, Helle Porsdam, and Yvonne Donders, 'Sleeping Beauty: The Right to Science as a Global Ethical Discourse', *Human Rights Quarterly* 42, no. 2 (2020): 332–56; Andrea Boggio and Cesare P.R. Romano, 'Freedom of Research and the Right to Science', in *The Freedom of Scientific Research*, ed. Simona Giordano, John Harris, and Lucio Piccirillo (Manchester: Manchester University

Press, 2020), 162–75; Samantha Besson, 'The Human Right to Science: Mapping the Issue', *European Journal of Human Rights*, Special Issue on the Human Right to Science, 4 (2015): 403–10; Lea Shaver, 'The Right to Science: Ensuring That Everyone Benefits from Scientific and Technological Progress', *European Journal of Human Rights*, Special Issue on the Human Right to Science, 4 (2015): 411–30; Jessica M. Wyndham and Margaret Weigers Vitullo, 'The Right to Science Whose Right? To What?', *European Journal of Human Rights*, Special Issue on the Human Right to Science, 4 (2015): 431–61; Samantha Besson, 'Science without Borders and the Boundaries of Human Rights – Who Owes the Human Right to Science?', *European Journal of Human Rights*, Special Issue on the Human Right to Science, 4 (2015): 462–85; Yvonne Donders, 'Balancing Interests: Limitations to the Right to Enjoy the Benefits of Scientific Progress and Its Applications', *European Journal of Human Rights*, Special Issue on the Human Right to Science, 4 (2015): 486–503; Schabas, 'Looking Back'; Eibe Riedel, 'Sleeping Beauty or Let Sleeping Dogs Lie? The Right of Everyone to Enjoy the Benefits of Scientific Progress and Its Applications (REBSPA)', in *Coexistence, Cooperation and Solidarity: Liber Amicorum Rüdiger Wolfrum*, ed. Holger P. Hestermeyer et al. (Leiden: Brill/Nijhoff, 2012), 503–21; Lea Shaver, 'The Right to Science and Culture', *Wisconsin Law Review* 1 (2010): 121–84; Amrei Müller, 'Remarks on the Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and Its Applications (Article 15(1)(b) ICESCR)', *Human Rights Law Review* 10, no. 4 (2010): 765–84; Chapman, 'Towards an Understanding'; Richard P. Claude, 'Scientists' Rights and the Human Right to the Benefits of Science', in *Core Obligations: Building A Framework for Economic, Social and Cultural Rights*, ed. Audrey R. Chapman and Sage Russell (Antwerp/Oxford/New York: Intersentia, 2002), 247–78.

5. UN General Assembly Resolution 3384 (XXX), *Declaration on the Use of Scientific and Technological* Progress *in the Interests of Peace and for the Benefit of Mankind*, UN Doc. A/RES/30/3384 (10 November 1975), http://www.un-documents.net/a30r3384.htm.
6. UNESCO, *Recommendation on Science and Scientific Researchers* (1974 Revised Text), UNESCO Doc. 41 C/36 (November 13, 2017), https://unesdoc.unesco.org/ark:/48223/pf0000260889.page=116.
7. UNESCO, *Declaration on Science and the Use of Scientific Knowledge*, UNESCO Doc. 30 C/15 (July 1, 1999), https://unesdoc.unesco.org/ark:/48223/pf0000116994; UNESCO, *Universal Declaration on Bioethics and Human Rights*, UNSECO Doc. 33 C/Res. 15 (October 19, 2005), https://unesdoc.unesco.org/ark:/48223/pf0000180371.
8. UNESCO, *Venice Statement*.
9. UN HCR, *2012 Report*; UN HCR, *Report of the Special Rapporteur in the field of cultural rights, Ms Farida Shaheed, on 'copyright policy and the right to science and culture'*, UN Doc. A/HRC/28/57 (December 24, 2014), https://digitallibrary.un.org/record/792652.
10. CESCR General Comment No. 25. That comment closed the sequel initiated by the publication of two earlier general comments on the other two rights protected by Article 15(1) ICESCR: CESCR General Comment No. 21, *The right of everyone to take part in cultural life (art. 15 (1) (a) ICESCR)*, UN Doc. E/C.12/GC/2121 (December 21, 2009), https://digitallibrary.un.org/record/679354; CESCR General Comment No. 17.
11. See CESCR General Comment No. 25, §2. For a first survey of that practice, see Yotova and Knoppers, 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing', 677–85.
12. For a full argument, see Besson, 'The "Human Right to Science"', 2023. See also Chapman, 'Towards an Understanding'.
13. UN General Assembly Resolution 217 A (III), *Universal Declaration of Human Rights*, UN Doc. A/RES/217 A (III) (December 10, 1948), https://documents-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/043/88/PDF/NR004388.pdf?OpenElement, Article 27: '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*.' (emphasis added).
14. ICESCR, Article 15: '1. The States Parties to the present Covenant recognize the right of everyone: (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. 2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for the conservation, the development and the diffusion of science and culture. 3. The States Parties to the present Covenant undertake to respect the freedom indispensable for scientific research and creative activity. 4. The States Parties to the present Covenant recognize the benefits to be derived from the encouragement and development of international contacts and co-operation in the scientific and cultural fields.' (emphasis added).

15. On this term, see Porsdam Mann, Porsdam and Donders, 'Sleeping Beauty'; Riedel, 'Sleeping Beauty or Let Sleeping Dogs Lie?'
16. See Besson, 'The "Human Right to Science"', 2023.
17. See for a full argument, Besson, 'The "Human Right to Science"', 2023. For a confirmation, see also CESCR General Comment No. 25, §11: 'The right enshrined in article 15(1)(b) encompasses not only a right to receive the benefits of the applications of scientific progress, but also a right to participate in scientific progress. Thus, it is the *right to participate in and to enjoy the benefits of scientific progress and its applications*.' (emphasis added).
18. See my Swiss National Science Foundation Research Project entitled '*Institutionalizing the Human Right to Science*' (2022–25).
19. See Robert K. Merton, 'The Normative Structure of Science', in *The Sociology of Science* (Chicago: University of Chicago Press, 1982), 268: '[…] A tower of ivory becomes untenable when its walls are under prolonged assault. After a long period of relative security, during which the pursuit and diffusion of knowledge had risen to a leading place if indeed not to the first rank in the scale of cultural values, scientists are compelled to vindicate the ways of science to man. Thus they have come full circle to the point of the reemergence of science in the modern world. Three centuries ago, when the institution of science could claim little independent warrant for social support, natural philosophers were likewise led to justify science as a means to the culturally validated ends of economic utility and the glorification of God. The pursuit of science was then no self-evident value. With the unending flow of achievement, however, instrumental was transformed into the terminal, means into the end. Thus fortified, scientist came to regard himself as independent of society and to consider science as a self-validating enterprise which was in society but not of it. A frontal assault on the autonomy of science was required to convert this sanguine isolationism into realistic participation in the revolutionary conflict of cultures. The joining of the issue has led to a clarification and reaffirmation of the ethos of modern science'.
20. Ulrich Beck, *Risk Society: Towards a New Modernity* (London/Newbury Park/Calif: Sage Publications, 1992).
21. See Mireille Delmas-Marty, *Résister, responsabiliser, anticiper, ou, comment humaniser la mondialisation* (Paris: Seuil, 2013).
22. On the latter, see Samantha Besson, *La due diligence en droit international*, Collected courses of the Hague Academy of International Law (vol. 409) (Leiden/Boston: Brill/Nijhoff, 2020), §60–85. For an English version of the book, see Samantha Besson, *Due Diligence in International Law* (Leiden/Boston: Brill/Nijhoff, 2023).
23. On the relationship between those three dimensions in international environmental law, see Besson, *La Due Diligence*, §432.
24. On that continuum, see International Law Association (ILA) Resolution 2/2014, *Declaration of Legal Principles Relating to Climate Change*, April 7–11, 2014, https://www.ila-hq.org/en_GB/documents/conference-resolution-no-2-english-washington-2014, Article 7A, Article 7B. See also Gerhard Hafner and Isabelle Buffard, 'Obligations of Prevention and the Precautionary Principle', in *The Law of International Responsibility*, ed. James Crawford et al., Oxford Commentaries on International Law (New York: Oxford University Press, 2010), 521–34.
25. On the conditions of due diligence, see Besson, *La Due Diligence*, §199–206.
26. On the variability of due diligence in general, see Besson, *La Due Diligence*, §247–77.

27. On the variability of due diligence in international human rights law, see Besson, *La Due Diligence*, §531–3.
28. See e.g. UN General Assembly Resolution 3384 (XXX), §2: 'All States shall take *appropriate measures to prevent the use of scientific and technological developments, particularly by the State organs, to limit or interfere with the enjoyment of the human rights and fundamental freedoms of the individual* as enshrined in the Universal Declaration of Human Rights, the International Covenants on Human Rights and other relevant international instruments.' (emphasis added).
29. See William Schabas, 'Codifying the human right to science', in this special issue; Schabas, 'Looking Back'.
30. See UNESCO, *Venice Statement*, §14(a) ('The duty to respect should include: a) to take measures, including legislative measures, to prevent and preclude *the utilization by third parties* of science and technologies *to the detriment of human rights and fundamental freedoms and the dignity of the human person by third parties*') (emphasis added), §14(d) ('[…] to take appropriate measures to prevent the use of science and technology *in a manner that could limit or interfere with the enjoyment of the human rights and fundamental freedoms*') (emphasis added). See also UNESCO, *1974/2017 Recommendation*, preamble: '*Recognizing* that: (a) scientific discoveries and related technological developments and applications *open up vast prospects for progress* made possible in particular by the optimum utilization of science and scientific methods for the benefit of humankind and for the preservation of peace and the reduction of international tensions but *may, at the same time, entail certain dangers which constitute a threat*, especially in cases where the results of scientific research are used against humankind's vital interests in order to prepare wars involving destruction on a massive scale or for purposes of the exploitation of one nation by another, or to the detriment of human rights or fundamental freedoms or the dignity of a human person, and in any event give rise to complex ethical and legal problems.' (emphasis added).
31. See CESCR General Comment No. 17, §35: '[…] States parties should *prevent the use of scientific and technical progress for purposes contrary to human rights and dignity*, including the rights to life, health and privacy, e.g. by excluding inventions from patentability whenever their commercialization would jeopardize the full realization of these rights.' (emphasis added). See also CESCR General Comment No. 25, §6: '[…] Thus, the development of *science in the service of peace and human rights* should be prioritized by States over other uses.' (emphasis added).
32. See Chapman, 'Towards an Understanding'.
33. See Porsdam Mann, Porsdam, and Donders, 'Sleeping Beauty'.
34. See Hannah Arendt, *The Origins of Totalitarianism* (New York: Harcourt Brace Jovanovich, 1973), 350.
35. With the encouragement of the CESCR lately: see e.g. CESCR General Comment No. 25, §72.
36. See Besson, *La Due Diligence*, §132, §228–31, §277, §417.
37. See Bartha M. Knoppers and Henry T. Greely, 'Biotechnologies Nibbling at the Legal "Human"', *Science* 336, no. 6472 (2019): 1455–57.
38. See e.g. Benoit Mayer, 'Climate Change Mitigation as an Obligation Under Human Rights Treaties?', *American Journal of International Law* 115, no. 3 (2021): 409–51.
39. For a presentation of each regime and a comparison, see Rumiana Yotova, 'Anticipatory duties under the human right to science and international biomedical law', in this special issue; Anna-Maria Hubert, 'Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology', in this special issue.
40. See Hubert, 'Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology', in this special issue; Anna-Maria Hubert, 'The Human Right to Science and Its Relationship to International Environmental Law', *European Journal of International Law* 31, no. 2 (2020): 625–56; Elisa Morgera, 'Fair and Equitable Benefit-Sharing at the Cross-Roads of the Human Right to Science and International Biodiversity Law', *Laws* 4, no. 4 (2015): 803–31.

41. See Yotova, 'Anticipatory duties under the human right to science and international biomedical law', in this special issue; Yotova and Knoppers, 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing'.
42. See Camila Perruso, 'Anticipation under the human right to science and under other social and cultural rights', in this special issue.
43. See e.g. CESCR, *2009 Guidelines*, §70(b) ('the measures taken *to prevent the use of scientific and technical progress for purposes which are contrary to the enjoyment of human dignity and human rights*.') (emphasis added); CESCR General Comment No. 17, §35. For a recent confirmation, see CESCR General Comment No. 25, §56. See also Yvonne Donders and Monika Plozza, 'Look before you leap: states' prevention and anticipation duties under the right to science', in this special issue.
44. See Besson, 'The "Human Right to Science"', 2023.
45. On human rights conflicts in general, see Samantha Besson, 'Human Rights in Relation: A Critical Reading of the ECtHR's Approach to Conflicts of Rights', in *When Human Rights Clash at the European Court of Human Rights: Conflict or Harmony?* ed. Stijn Smet and Eva Brems (Oxford: Oxford University Press, 2017), 23–37.
46. See Besson, 'The "Human Right to Science"', 2023. See also, albeit from a strictly democratic perspective, Zeynep Pamuk, 'Dangerous Science and the Limits of Free Inquiry', in *Politics and Expertise. How to Use Science in a Democratic Society* (Princeton: Princeton University Press, 2021), 161–84; Zeynep Pamuk, 'Risk and Fear: Restricting Science under Uncertainty', *Journal of Applied Philosophy* 38, no. 3 (2021): 444–60.
47. On the dualist dimension of the HRS, see UN HCR, *2012 Report*, §43; CESCR General Comment No. 17, §35; CESCR, *2009 Guidelines*, §70. See also CESCR General Comment No. 25, §6, §74 ('States parties have to adopt policies and measures that *expand the benefits* of these new technologies while at the same time *reducing their risks*.') (emphasis added), §57 ('The precautionary principle should not hinder and prevent scientific progress, which is *beneficial for humanity*. Nonetheless, it should be able to address available *risks for human health and the environment, inter alia*.') (emphasis added).
48. See Besson, 'The "Human Right to Science"', 2023. See also Christopher G. Weeramantry, 'The Problems, the Project, and the Prognosis', in *Human Rights and Scientific and Technological Development: Studies on the Affirmative Use of Science and Technology for the Furtherance of Human Rights*, ed. Christopher G. Weeramantry (New York: United Nations University Press, 1990); Chapman, 'Towards an Understanding'; Schabas, 'Looking Back'; Schabas, 'Codifying the human right to science', in this special issue. Note that I am not distinguishing here between the 'science' itself and its later 'uses' or 'applications'. It is very difficult to do so, indeed, especially in areas of research that purport to be applied and used eventually. So, scientific knowledge itself may be considered to be able to harm as much as to benefit once it is applied and hence may be restricted with regard to that harm to come or risk of harm. Of course, this is not a matter of the scientists themselves knowing or foreseeing their research will harm or benefit, but of the human right duty-bearing State(s) only. As a result, I am not only considering cases of direct harming or benefiting by scientists in the course of their research, for instance through medical experiments.
49. See also Boggio, 'The Right to Participate in and Enjoy the Benefits of Scientific Progress and Its Applications', 49.
50. On science as a public good, see e.g. Shaver, 'The Right to Science and Culture'; Besson, 'The "Human Right to Science"', 2023.
51. Besson, 'The "Human Right to Science"', 2023, by reference to Denise G. Réaume, 'Individuals, Groups, and Rights to Public Goods', *University of Toronto Law Journal* 38, no. 1 (1988): 10–11.
52. See e.g. 'Global Citizens' Assembly on Genome Editing: Connecting Citizens, Science and Global Governance', *Global Citizens' Assembly on Genome Editing* (blog), n.d., https://www.globalca.org/.
53. See CESCR General Comment No. 25, §56–7: '56. Participation also includes the *right to information and participation in controlling the risks* involved in particular scientific

processes and its applications. […] 57. […] Thus, in controversial cases, *participation and transparency become crucial because the risks and potential of some technical advances or some scientific research should be made public in order to enable society, through informed, transparent and participatory public deliberation, to decide whether or not the risks are acceptable*.' (emphasis added).

54. See Besson, 'The "Human Right to Science"', 2023.
55. On the distinction between the human rights 'duties' of the States of jurisdiction and the 'responsibilities' for human rights of all other institutions and individual or collective subjects to cooperate and assist States in complying with their (jurisdictional) duties under international human rights law, see Samantha Besson, 'The Bearers of Human Rights Duties and Responsibilities for Human Rights – A Quiet (R)Evolution', *Social Philosophy and Policy* 32, no. 1 (2015): 244–68. For an application to the HRS, see Besson, 'The Human Right to Science', 2015.
56. See Besson, 'The "Human Right to Science"', 2023.
57. Ibid.
58. See Besson, 'The Bearers of Human Rights and Responsibilities', 2015; Besson, 'The "Human Right to Science"', 2023.
59. See e.g. UN HRC, *2012 Report*, §68. See also CESCR General Comment No. 25, §52. See also Müller, 'Remarks on the Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and Its Applications (Article 15(1)(b) ICESCR)', 781–82.
60. See e.g. CESCR General Comment No. 25, §74: '[…] Nevertheless, there are no easy solutions given the varied nature of these new technologies and their complex effects. The Committee will therefore constantly monitor the impact of these new technologies on the enjoyment of economic, social and cultural rights. For the Committee, three elements remain very important: firstly, *international cooperation* should be enhanced in this field as these technologies need *global regulations* in order to be effectively managed.' (emphasis added).
61. See Yotova, 'Anticipatory duties under the human right to science and international biomedical law', in this special issue.
62. See Christopher G. Weeramantry, 'Conclusions and Recommendations', in *Human Rights and Scientific and Technological Development: Studies on the Affirmative Use of Science and Technology for the Furtherance of Human Rights*, ed. Christopher G. Weeramantry (New York: United Nations University Press, 1990); Besson, 'The Human Right to Science', 2015. See also Amrei Müller, 'Anticipation under the human right to science (HRS): sketching the public institutional framework. The example of scientific responses to the appearance of SARS-CoV-2', in this special issue.
63. See Yotova, 'Anticipatory duties under the human right to science and international biomedical law', in this special issue; Hubert, 'Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology', in this special issue.
64. See Besson, *La Due Diligence*, §273, §436.
65. See e.g. CESCR General Comment No. 25, §74, §56.
66. See Samantha Besson, 'Human Rights and Justification: A Reply to Mattias Kumm', in *Human Rights: Moral or Political?* ed. Adam Etinson, vol. 1 (Oxford: Oxford University Press, 2019), 262–68.
67. See Besson, 'The "Human Right to Science"', 2023, by reference to Réaume, 'Individuals, Groups, and Rights to Public Goods', 10, 15: 'there is no end product because, in a sense, [participatory goods] are never completed, but are continuously reinterpreted and re-created by each generation'. See also Michela Massimi, 'A Human Rights Approach to Scientific Progress: The Deontic Framework', in *New Philosophical Perspectives on Scientific Progress*, ed. Yafeng Shan (New York/London: Routledge, 2022), 392–412.
68. See Yotova, 'Anticipatory duties under the human right to science and international biomedical law', in this special issue; Hubert, 'Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology', in this special issue.

69. On those assessments, see Perruso, 'Anticipation under the human right to science and under other social and cultural rights', in this special issue.
70. See Besson, *La Due Diligence*, §223 et seq., §233.
71. See CESCR General Comment No. 25, §56: '[…] In this context, the precautionary principle plays an important role. *This principle demands that, in the absence of full scientific certainty, when an action or policy may lead to unacceptable harm to the public or the environment, actions will be taken to avoid or diminish that harm. Unacceptable harm includes harm to humans or to the environment that is: (a) threatening to human life or health; (b) serious and effectively irreversible; (c) inequitable to present or future generations; or (d) imposed without adequate consideration of the human rights of those affected.* Technological and *human rights impact assessments* are tools that help to identify potential risks early in the process and the use of scientific applications.' (emphasis added).
72. See UNESCO and World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), 'The Precautionary Principle' (Paris: UNESCO, March 2005), https://unesdoc.unesco.org/ark:/48223/pf0000139578.
73. See Besson, *La Due Diligence*, §555.
74. Merton, 'The Normative Structure of Science', 268.

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Codifying the human right to science

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ABSTRACT

The human right to science is set out in the Universal Declaration of Human Rights and the International Covenant on Economic, Social and Cultural Rights. The two texts, which were adopted consecutively, are similar but not identical. Conflicts in formulating the right to science in international human rights law were rooted in the ideological quarrels of the Cold War. The *travaux préparatoires* indicate debate about whether the right was essentially about the freedoms of scientists or about the purposes of science, including concern about abuse. Article 15(3) of the Covenant confirms recognition of 'the freedom indispensable for scientific research … ' The Soviet Union promoted the view that scientific research must pursue progressive aims but was unsuccessful in its attempts to entrench this in the texts. UNESCO's contribution to the Declaration was insignificant but it had considerable influence on the Covenant text. In 1950 and 1951, UNESCO issued important and influential expert statements challenging 'scientific' arguments of racial supremacists, confirming in practice its own understanding of the direction that science should take.

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In his closing address at the San Francisco Conference, Jan Christian Smuts, the head of the South African delegation and the principal author of the preamble of the Charter of the United Nations, spoke of the 'mounting horror of war' for men and women, adding that 'science warns them to expect far worse in future war'.[1] Six weeks later, 'advances' in scientific research destroyed two Japanese cities and their inhabitants. The following year, several prominent German scientists were tried for war crimes and crimes against humanity with respect to medical experiments on human subjects. 'Obviously all of these experiments involving brutalities, tortures, disabling injury, and death were performed in complete disregard of international conventions, the laws and customs of war, the general principles of criminal law as derived from the criminal laws of all civilised nations, and Control Council Law No. 10', said the judgment of the American military tribunal sitting in courtroom 600 of the Nuremberg Palace of Justice. 'Manifestly human experiments under such conditions are contrary to "the principles of the law

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of nations as they result from the usages established among civilised peoples, from the laws of humanity, and from the dictates of public conscience".'[2]

It was not always easy at the time to distinguish between abusive science and progressive science. The worst of modern weaponry, the atomic bomb, had been developed and used by those who took credit for the triumph over Nazi evil. The defendants in the trial of the Nazi doctors pointed to experiments on human subjects in American prisoners who were infected with serious diseases. As for Nazi race science, purporting to justify white supremacy, it had its enthusiasts within scientific communities in Britain, France, and the United States. Very recently, Mikel Mancisidor has noted 'the state of distrust ("what the scientists will do to us next") which pervaded the debate on the development of science when fully disconnected from values and aims. The role of science and technology in Nazi war crimes, and in the atomic bombs' was 'very present' in the minds of those who developed the UN institutions and who crafted the early instruments of international human rights law.[3]

Drafting the Universal Declaration of Human Rights

The 'Draft *Declaration of the International Rights and Duties of Man*' prepared by the Inter-American Juridical Committee is the ancestor of the right to science provisions in the Universal Declaration of Human Rights and the International Covenant on Economics, Social and Cultural Rights:

> Article 15
>
> Right to Share in Benefits of Science
>
> Every person has the right to share in the benefits accruing from the discoveries and inventions of science, under conditions which permit a fair return to the industry and skill of those responsible for the discovery or invention.
>
> The state has the duty to encourage the development of the arts and sciences, but it must see to it that the laws for the protection of trademarks, patents and copyrights are not used for the establishment of monopolies which might prevent all persons from sharing in the benefits of science. It is the duty of the state to protect the citizen against the use of scientific discoveries in a manner to create fear and unrest among the people.[4]

The text, dated 31 December 1945, was signed by four members of the Committee, Francisco Campos, Félix Nieto del Rio, Charles G. Fenwick and Antonio Gómez Robledo.[5]

The initial materials to be considered in drafting of the international bill of rights prepared by the Secretariat of the United Nations Commission on Human Rights contemplated a text on the 'right to share in the benefits of science'.[6] The preliminary Secretariat draft, attributed to John Humphrey, contained the following: 'Everyone has the right … to share in the benefits of science.'[7] The Documented Outline of the Secretariat, consisting of several hundred pages, drew on a range of sources, some of them prepared by individuals and non-governmental organisations, as well as national constitutions. For certain rights, such as freedom of expression and the right to a fair trial, a broad range of sources was produced. The text of the Inter-American Juridical Committee was the only source for a 'right to science'.[8]

The right to science provision was discussed only briefly by the Drafting Committee of the Commission on Human Rights during its June 1947 sessions. When Peng-chun

Chang of China asked for an explanation of the phrase 'share in the benefits of science', the Chilean member, Hernán Santa Cruz, invoked the draft of the Inter-American Juridical Committee stating that 'scientific inventions should belong to society and be enjoyed by all'. The Commission's chairman, Eleanor Roosevelt, announced that the provision was amended to read: 'Everyone has the right … to share in the benefits that result from scientific inventions and discoveries'. She said a footnote could be included stating that it might be proper to include the substance of this Article in the Preamble.[9] The Drafting Committee's Report dropped the reference to inventions. A parenthetical note said: 'It was the opinion of some of the members that the thought back of this Article should be included in the Preamble.'[10] Later that year, Ecuador proposed a more elaborate version: 'Right to enjoy the fruits of his discoveries, inventions, and other scientific, literary and artistic activities under conditions prescribed by law, and to share in the benefits accruing from scientific discoveries and inventions.'[11]

By December 1947, the draft International Bill of Rights had been split into two separate instruments, a manifesto or declaration and a treaty or covenant. Economic, social, and cultural rights, including the right to share in the benefits of science, were only addressed in the first of the two. In the Working Group of the Commission on Human Rights on the draft declaration, the suggestion that the provision be relegated to the preamble was revived. The text as a substantive rather than a preambular provision barely survived, with three votes to retain it, one opposed and two abstentions.[12] The Soviet delegate asked 'what was meant by sharing in the benefits that resulted from scientific discoveries'. He thought the phrase appeared to imply an obligation to reveal patents of scientific discoveries. Eleanor Roosevelt, who chaired the Working Group, said 'the idea of the Drafting Committee had been to stress the universality of such sharing'. She proposed inserting a comment specifying that the text did not imply an obligation to reveal secrets of scientific discoveries that had been patented.[13] The Report of the Working Group contained such a comment on intellectual property[14] but it was not reproduced in the final Report of the Commission's December 1947 session.[15] The idea is rather odd because it is inherent in the patenting process that the discovery be revealed and hence there is no secret.

The Commission on Human Rights adopted its final draft of the Universal Declaration of Human Rights during its June 1948 session. René Cassin of France proposed inserting the words 'in scientific research and' between the words 'share' and 'in the benefits'.[16] Cassin explained that 'cultural life included science but that he wished to lay particular stress on the participation of even uneducated persons in scientific progress'.[17] Peng-chun Chang proposed replacing 'share in the benefits that result from scientific discoveries' with 'share in scientific advancement'. The Commission's reigning intellectual, Chang recalled that 'the phrase was derived from Bacon',[18] presumably a reference to Francis Bacon's *Of the Advancement and Proficiencies of Learning: Or the Partitions of Sciences*, published in 1674. Cassin withdrew his own amendment and supported that of Chang.[19] The Soviet representative, Alexei P. Pavlov, stressed that 'the task of science was to work for the advancement of peaceful aims and to make human life better'. He said that in the Soviet Union 'science and culture belonged to all and tremendous progress had been achieved in making the benefits of culture accessible to broadest masses'.[20] Pavlov proposed an amendment: 'In the advancement of science which should serve the interests of the progress of mankind, the cause of peace, and co-operation

amongst peoples.'[21] After the Soviet amendment was put to a vote and rejected, the Chinese amendment was adopted.[22]

The final negotiations of the Universal Declaration of Human Rights took place in the third General Assembly session in late 1948. The Soviets renewed the proposal about the purposes of science although they were no more successful the second time around.[23] Pavlov emphasised the importance of science serving the interests of progress, democracy, and peace, invoking 'the atmosphere of terror which prevailed throughout the world owing to the application of scientific discoveries for destructive purposes. According to the Press of certain countries, scientists were at present engaged in perfecting a bacteriological weapon which would destroy 180 million human beings at one blow.'[24] Roosevelt spoke against the Soviet amendment. 'The United States delegation would under no circumstances agree that science should be placed at the service of politics', she said. 'Yet that might be the practical effect of the USSR amendment.'[25] Her comments were echoed by delegates from Australia,[26] Belgium,[27] Cuba,[28] the Dominican Republic,[29] Lebanon, [30] Norway,[31] and Uruguay.[32] The British delegate referred to the Nazi ideologue Alfred Rosenberg, who had been 'the propagandist of a doctrine which bestowed racial superiority upon Germany. That was why it was necessary to take care in the declaration of human rights not to state a principle which might be misinterpreted and might be used for purposes prejudicial to the rights of the individual.'[33] But there was also significant sympathy with the Soviet position. Argentina said it could accept the proposal if the reference to democracy was dropped.[34] Chile,[35] Ecuador,[36] and Venezuela[37] expressed similar sentiments. France's Cassin said he agreed 'that science must be put at the service of progress and of peace, but believed that the problem raised by the USSR delegation fell outside the framework of the declaration of human rights'.[38]

The Third Committee of the General Assembly considered a number of changes to the text adopted by the Commission. Peru wished to add the word 'freely' in the opening words of the provision so as 'to recognise the freedom of creative thought, in order to protect it from harmful pressures which were only too frequent in recent history'.[39] Cuba proposed modifying the final phrase by replacing 'share' with 'participate'.[40] Guy Pérez-Cisneros explained that the 'the Cuban delegation did not consider that everyone was sufficiently gifted to play a part in scientific advancement'.[41] Cassin agreed with the proposal, recalling that 'the question had been debated at length by the Commission on Human Rights, where several delegations had maintained that even if all persons could not play an equal part in scientific progress, they should indisputably be able to participate in the benefits derived from it'.[42] China prepared a revised version that incorporated the amendments of Peru and Cuba along with one of its own. Chang argued that there were two aspects to the right, that of everyone to share in the benefits of scientific advancement and that of the right to participate in the work of scientific creation. He proposed adding the words 'and its benefits',[43] which brought the text back to the original idea expressed by the Inter-American Juridical Committee. The first paragraph of the article, which became article 27(1) in the final text of the Declaration, was adopted unanimously by the Third Committee.[44]

UNESCO's contribution

UNESCO's mandate resonates through the Universal Declaration of Human Rights, especially in articles 26, on education, and 27, on science and culture. The ancestor of UNESCO was the International Committee of Intellectual Cooperation, set up by the League of Nations in September 1921. Its membership included prominent scientists such as Albert Einstein and Marie Curie.[45] Three years later, the League Assembly welcomed the establishment of the International Institute of Intellectual Cooperation, based in Paris. A new body conceived as part of the new post-Second World War institutional framework was to be named the United Nations Educational and Cultural Organisation. 'Science' was only added to its name in the course of the London Conference of November 1945 when the Constitution was adopted.[46]

Representatives of UNESCO regularly attended the sessions of the Commission on Human Rights and the Economic and Social Council when the drafts of the Universal Declaration were being discussed. On its own initiative, UNESCO's Committee on the Philosophic Principles of the Rights of Man prepared a document compiled 'on the basis of a survey of the opinion of scholars in the various parts of the world' that was intended to address 'the intellectual bases of a modern bill of rights'.[47] It referred enthusiastically to the importance of economic and social rights, noting that 'the increased accessibility of economic and social rights was achieved as a consequence of the advances of science'. The document said: 'Finally, there are few to deny, in the retrospect of technological advances today, the right of all to share in the advancing gains of civilisation and to have full access to the enjoyment of cultural opportunities and material improvements'.[48] Fifteen categories of fundamental rights were identified of which the fifteenth was 'The right to share in progress': 'Every man has the right to full access to the enjoyment of the technical and cultural achievements of civilisation.'[49]

The UNESCO report was very poorly received by the Commission on Human Rights. The Belgian representative, Fernand Dehousse, said he was 'very sorry' to see the document. Dehousse was angered that a Belgian publication, *Synthèse,* had published an account of the UNESCO document without even mentioning the Commission on Human Rights. He said it would be 'regrettable' if the initiative had been taken by UNESCO alone and not at the request of the UN human rights bodies. John Humphrey, the Secretary of the Commission, confirmed that UNESCO had done this on its own.[50] Humphrey said he had initially planned to circulate the UNESCO report but the Commission decided against this and no reference was ever made to its contents.[51] This was an overreaction. Ten days after the brouhaha in the Commission, UNESCO wrote to Eleanor Roosevelt, the Chairman of the Commission, clarifying that the report was indeed issued in response to an invitation to comment on the report of the Drafting Committee made in July 1947.[52]

On a few occasions the UNESCO representatives intervened in the debates.[53] When article 27 was discussed by the Working Group of the Commission, Jacques Havet took the floor to 'stress the importance' of the provision but he spoke about culture rather than science.[54] In July 1948, UNESCO published a very substantial study as a contribution to the negotiations. Two rather brief chapters addressed issues related to the right to science. J.M. Burgers took the perspective of the 'scientific worker', exploring the scope of rights and obligations. His article was more about the 'rights of scientists'

than the 'right to science'.[55] W.A. Noyes, an American chemistry professor, pointed to the relationship between science and warfare. The scientist, 'whether he likes it or not', is 'tied to the military destinies of the various countries', he wrote. 'The Rights of Man and the rights of the scientist have become, therefore, inextricably entangled.' Noyes concluded that 'the immediate objective of the scientists should be to ensure that all levels of society in all nations are freed from economic anxiety'.[56] The 1948 UNESCO study was never referred to in the General Assembly debates.

As the Universal Declaration was being completed, UNESCO was requested by the Sub-Commission on the Prevention of Discrimination and the Protection of Minorities, a subsidiary organ of the Commission on Human Rights, to consider 'as a first step, the desirability of initiating and recommending the general adoption of a programme of disseminating scientific facts with regard to race'.[57] This was later reformulated more purposely in a resolution of the Economic and Social Council, the phrase 'with regard to race' replaced with 'designed to remove what is commonly known as racial prejudice'.[58] In May 1949, UNESCO reported on implementation of the resolution, noting that 'recognised scientific authorities' in various parts of the world had made statements during the Second World War concerning Nazi racial theories, including Britain's Royal Anthropological Society, the American Anthropological Association, the Society for the Study of Social Issues, and the Brazilian Society of Anthropologists. UNESCO said a compilation and publication of such statements, with a suitable introduction, could be done almost immediately. It also referred to individual anthropologists whose work was not readily accessible to a broad public. Their materials could be organised around several themes, such as race from the standpoint of biology, anthropology, and psychology, the cultural contributions of 'the races of mankind', the 'irrational nature of race prejudice', its cost, 'successful experiments in race relations', and methods of combating race prejudice. The report said an expert group would be convened in July 1949 to issue a statement on 'racial problems and racial prejudice'.[59]

Before the proposed UNESCO meeting of experts, the General Conference of UNESCO instructed the Director-General to 'study and collect scientific materials concerning questions of race', to 'give wide diffusion to the scientific information collected' and to 'prepare an educational campaign based on this information'.[60] The reference to 'questions of race' was clearly more reserved than the language used in the ECOSOC resolution, which had spoken of 'racial prejudice'. Organisation of the expert gathering was the responsibility of UNESCO's head of social sciences, Arthur Ramos, who died suddenly only weeks before the meeting. Ramos had set the tone with an article in UNESCO's journal, *Social Sciences*. '[T]he "racial" technique has led to one of the greatest states of disequilibrium that exist, namely war. The present century has just paid tribute in the shape of the European nations' Second Great War, of which there were many causes; but one cause was undoubtedly the philosophy of racial domination espoused by the racialists of our time, that is to say the Germans', he wrote. 'We see then, in the last analysis, that racialism is a direct result of Europeanisation and imperialism.'[61]

The Committee of Experts on Race Problems convened at UNESCO headquarters in Paris in December 1949. In preparation for the meeting, UNESCO issued a detailed memorandum that appears to be the outline of a book, developing the themes that were identified in the report on implementation of the resolution earlier that year.[62] The Committee had eight members: E. Franklin Frazier, Ashley Montagu, Ernest

Beaglehold, Juan Comas, L.A. Costa Pinto, Morris Ginsberg, Humayun Kabir, and Claude Levi-Strauss. Frazier, head of the sociology department at Howard University and the first Black president of the American Sociological Association, was elected chairman.[63] Montagu was designated as rapporteur.[64] It was 'an international dream team of scholars' assembled to draft 'the final rebuttal to Nazism and eugenicists worldwide'.[65]

Edward Lawson represented the United Nations Secretariat as an observer. He explained that the Division of Human Rights had reached the conclusion that it was 'scientifically illegitimate' to attempt to define the concept of race. Lawson told the expert group that the Secretariat felt what was needed was 'a clear, concise statement of fact about race which could be disseminated all over the world and which would serve as a basis for eliminating false ideas about race'.[66] His words were echoed by Montagu who explained that genetical and social evidence from recent research showed 'race questions were not of a biological character'. Montagu said differences in genes among humans were insignificant, and that all belonged to the human race 'with superficial physical differences'. The real 'species character' common to humans was 'educability or plasticity'.[67] Montagu was himself somewhat of an *enfant terrible* on the subject. Trained in the United States by Ruth Benedict and Franz Boas, he had advanced his controversial positions in scholarly debates,[68] apparently 'with little humility and, probably as a result, little effect'.[69] Montagu was the author of a best-selling monograph, *Man's Most Dangerous Myth: The Fallacy of Race*.[70]

Entitled 'The Race Question', the statement noted the relatively narrow use of the term by anthropologists, referring to the current usage of three major divisions, Mongoloid, Negroid and Caucasoid. But it said '[t]o most people, a race is any group of people whom they choose to describe as a race'. It explained that Englishmen and Frenchmen were not a race, nor were Catholics, Protestants, Moslems or Jews, or people who were 'culturally' Turkish or Chinese. The statement recommended that 'when the term "race" is used in popular parlance, it would be better when speaking of human races to drop the term "race" altogether and speak of ethnic groups'. The statement continued:

For all practical social purposes 'race' is not so much a biological phenomenon as a social myth. The myth of 'race' has created an enormous amount of human and social damage. In recent years it has taken a heavy toll in human lives and caused untold suffering. It still prevents the normal development of millions of human beings and deprives civilisation of the effective co-operation of productive minds. The biological differences between ethnic groups should be disregarded from the standpoint of social acceptance and social action. The unity of mankind from both the biological and social viewpoints is the main thing. To recognise this and to act accordingly is the first requirement of modern man.[71]

The very specific issue of 'race mixture' was also confronted. Montagu's original draft contained a strong plea favouring the benefits of 'hybridisation'. He wrote that 'the evidence points unequivocally to the fact that race mixture is always biologically good in its effects … Race mixture is biologically one of the greatest of all powers for the creation of novel and desirable traits in man.'[72] But this was a step too far for some of the experts, and in the final version reference to any beneficial consequences of 'race mixture' were removed. Montagu's sentence about 'convincing evidence' was changed to state that there was nothing to indicate 'that race mixture of itself produces biologically bad effects. Statements that human hybrids frequently show undesirable traits, both

physically and mentally, physical disharmonies and mental degeneracies are not supported by the facts.' Consequently, said the UNESCO statement, there was 'no biological justification for prohibiting intermarriage between persons of different ethnic groups'.

The UNESCO statement is given great credit for its positive impact on scientific discussion as well as on public opinion.[73] A headline on page 1 of the *New York Times* proclaimed 'No Scientific Basis for Race Bias Found by World Panel of Experts'.[74] After decades of debate among recognised scientists that ultimately did much to fuel the genocidal plans of the Nazis and their supporters, an authoritative international body backed by established scholars had dramatically framed the discussion, both within the academic community but also in public opinion generally. According to Elazar Barkan, the Statement 'highlighted the dramatic transformation in the scientific and public understanding of the race concept'.[75] UNESCO's press release described it as 'the most far-reaching and competent pronouncement of its kind ever made and provides a scientific foundation for some of the basic principles expressed in the Universal Declaration of Human Rights'.[76] Later in the year, Montagu published a detailed commentary on the 1950 statement.[77]

Ashley Montagu had been right in expecting the 1950 Statement would not please everyone, and he may have been too optimistic in thinking it was 'bombproof'. Within a week of its publication, a critical letter by William B. Fagg, writing on behalf of the Royal Anthropological Institute, was published in *The Times*. It claimed that several propositions in the Statement were 'distinctly controversial in the present state of our knowledge'. Fagg said the statement that 'race is less a biological fact than a social myth' was 'too simplified'. As for the conclusion that humans are driven towards universal brotherhood and cooperation, Fagg said 'surely very few anthropologists anywhere would yet venture to commit themselves' to this.[78] In the months that followed, the Institute's journal, *Man*, published several letters from English academics challenging the Statement on a variety of grounds.[79] At least one was known for holding quite racist views about 'interbreeding' and the positive consequences of competition between races.[80] The editor of *Man* dismissed the UNESCO document as the 'Ashley Montagu Statement'.[81] A lengthy, mocking critique appeared in the *Eugenics Review*.[82] Physical anthropologists and biologists grumbled that the expert panel had been dominated by social scientists, with the exception of Montagu, whom many regarded as a maverick. The journal of the Royal Anthropological Institute noted the views of prominent physical anthropologists who, while in 'cordial agreement with the purpose and essential thesis of the document' seemed to view it as simplistic.[83] Although England provided the core of the opposition to the UNESCO Statement, there were also a few critical comments from elsewhere including the United States.[84]

The Director-General of UNESCO himself, Jaime Torres Bodet, explained to one of those consulted on the 1950 statement that it had been widely distributed and well received. 'It has given hope and courage to many people', he said, and did not think that 'in the present state of science, the text of this document could be altered'. But he added that a new meeting of physical anthropologists and geneticists would be convened in early June 1951 'in order to show our scientific impartiality'.[85] There was a recognition that the findings of the 1950 meeting, which had been composed of sociologists and cultural anthropologists, needed to be reinforced by the views of physical anthropologists and geneticists.

Perrin Selcer has pointed to the 'more matter-of-fact tone' of the second statement. It based itself on 'the rather esoteric argument that biological diversity must be understood through a population rather than a typological approach and more clearly hedged on the actual equality of races. Nevertheless, the second statement surprised even many of its own signatories with the strength of its antiracism, and UNESCO successfully presented it as another weapon in the fight against racial prejudice.'[86] For Michelle Brattain, 'the second statement project revealed how much the categories, premises, empirical records, and authority of an older, supposedly discredited body of work once dedicated to measuring difference continued to influence the science of race'.[87] Alfred Métraux, who directed UNESCO's work against racism in the 1950s, was enthusiastic about the June 1951 meeting. He had anticipated a 'great battle'[88] but ultimately felt the results were constructive. Far from 'invalidating' the 1950 Statement, he felt that the earlier document had been 'reinforced'.[89] Writing to his wife, he described 'une très bonne réunion … Ashley Montagu s'est comporté mieux que prévu et, je dois le reconnaître, il a apporté beaucoup à la réunion en se présentant comme une cible.'[90]

To make its message accessible to young people. UNESCO published a picture book entitled *What Is Race? Evidence from Scientists*.'[91] It also undertook an investigation into the factors that 'produced in Brazil a spirit of tolerance and a degree of harmony in inter-racial relations in strong contrast with the morbid intransigence of other types of culture'. Short monographs, averaging about 50 pages each, were produced as part of a collection entitled 'The Race Question in Modern Science'.[92]

UNESCO returned to the issue in the 1960s, issuing two more declarations.[93] This work was consolidated in 1978 with the adoption of a political statement crafted by international lawyers, entitled UNESCO Declaration on Race and Racial Prejudice.[94]

Drafting the International Covenant

With the adoption of the Universal Declaration of Human Rights, on 10 December 1948, the attention of the Commission on Human Rights and other United Nations organs turned to the draft Covenant, whose adoption was expected to take another year or two. The drafts adopted by the Commission in 1947 and 1948 did not include economic, social, and cultural rights.[95] In 1949, the debate began about the place of such rights, including the right to science, within the treaty. The Commission's 1949 text was accompanied by draft provisions on economic and social rights for what was then being called Part II of the Covenant. These were derived from articles 22 to 26 of the Universal Declaration but there was nothing reflecting article 27(1).[96] In 1950, the Soviet Union submitted a resolution in the General Assembly setting out a catalogue of economic, social, and cultural rights for incorporation in the Covenant. It included an obligation on the State to 'ensure the development of science and education in the interests of progress and democracy and in the interests of ensuring international peace and co-operation'.[97]

If UNESCO's contribution to the Universal Declaration was inconsequential, the same cannot be said of the text on the right to science in the International Covenant on Economic, Social, and Cultural Rights where its engagement was quite seminal. Within a few months of the adoption of the Universal Declaration of Human Rights by the United Nations General Assembly, on 10 December 1948, Bart J. Bok published an article in

the *Bulletin of the Atomic Scientists* entitled 'Freedom of science and the Universal Declaration of Human Rights'. A Dutch-American astronomer, Bok was responding to an invitation from Julian Huxley, the English evolutionary biologist and the first Director-General of UNESCO, to address the challenges posed to 'men of science' by increased political pressure from the State. At the time, Huxley's concerns were focussed on the triumph of the Lysenko school in Soviet genetics, a development attributable to political pressure. Huxley said that Nazi Germany had paid for its attacks on scientific autonomy and unity 'by a deterioration in the quality of its scientific work' and he predicted the same fate awaited the Soviet Union.[98]

Bok questioned whether 'scientific advance' was dependent upon full freedom for the scientist. He pointed to totalitarian states that 'restrict and pervert science'.[99] Bok welcomed the adoption of the Universal Declaration of Human Rights as a guide to scientists in the development of their own 'Charter for Scientists' as proposed by Huxley and others. He pointed to the special importance of three provisions of the Universal Declaration of Human Rights: article 12, on the right to privacy, article 13, on freedom of movement, and article 19, on freedom of expression. Then he turned to article 27, the provision of the Declaration that actually refers to science and that, said Bok, 'is especially important to the scientist'. Bok wrote that '[i]f this Article had been written twenty years ago, it would, to the majority of the world's scientists, have seemed like an admirable statement, but it would not have been considered by them as especially significant for the scientist.' He noted 'a wide questioning of the scientist's right to free participation in community activities. In the days of the atomic bomb, scientists are supposed to be much more careful than non-scientists in choice of organisations that they join or in the popular causes that they wish to espouse.'[100] Bok set out his own amended version of the 'Charter for Scientists'. Bok's discussion of 'freedom of science' was subsequently published by UNESCO as a booklet in a French translation.[101]

Bok's study was largely adopted in a UNESCO submission to the Commission on Human Rights for consideration during the drafting of the treaty provisions on economic, social, and cultural rights. The lengthy document focussed largely on the freedoms of scientists rather than on the right to science. With reference to the Bok study, UNESCO proposed including special rights that were, in reality, little more than specific formulations of freedom of expression and freedom of information. It called for recognition of a right to obtain information on the aims of research projects, to publish results of research, 'and the fullest possible freedom to discuss the development of their work with other scientists, except where there might be social or moral grounds for restricting these privileges'. In harmony with Bok's approach, UNESCO also envisaged certain duties: '[t]o examine carefully the meaning and aim of the work carried out by the scientist and, when it is in the service of other men, to determine their purposes and to assess the moral problems at stake', '[t]o contribute towards the progress of science in those fields that will most benefit mankind as a whole and to bring the fullest influence to bear to prevent any abuse of science', and '[t]o assist in the education of the people and of governmental authorities by explaining to them the aims, methods and spirit of scientific research and enabling them to follow scientific progress'.[102]

UNESCO considered that the Covenant should include 'two quite general clauses in line with the first paragraph of Article 27 of the Universal Declaration'. The first would formulate the obligation 'to allow all, irrespective of race, sex or religion, the

widest possible access to the various forms of cultural life'. The second would provide 'the guarantee that artists and scientists would enjoy the fullest freedom and security'. The right to benefit from science had been totally forgotten. In its place was protection of the rights of scientists. UNESCO said that '[t]hese articles should be framed as to draw the attention of governments to the essentially international and universal character of cultural life and to the danger of restricting access to culture of certain national groups only'.[103]

The following year, UNESCO's Director-General proposed a text on the subject that recognised 'the enjoyment of the benefits resulting from scientific progress and its application':

> Article (d). The Signatory States undertake to encourage the preservation, development and propagation of science and culture by every appropriate means;
>
> (a) By facilitating for all access to manifestations of national and international cultural life, such as books, publications and works of art, and also the enjoyment of the benefits resulting from scientific progress and its application;
> (b) by preserving and protecting the inheritance of books, works of art and other monuments and objects of historic, scientific and cultural interest;
> (c) by assuring liberty and security to scholars and artists in their work and seeing that they enjoy material conditions necessary for research and creation;
> (d) by guaranteeing the free cultural development of racial and linguistic minorities.[104]

A draft article submitted by Chile a few weeks later explicitly acknowledged that it was inspired by the UNESCO text:

> The States parties to the Covenant undertake to encourage by all appropriate means the conservation, the development and the diffusion of science and culture, in accordance with the principle of non-discrimination enunciated in paragraph 1 of Article 1 of this Covenant.

They recognise that it is one of their principal aims to ensure conditions which will permit every one:

1. to take part in cultural life;
2. to enjoy the benefits of scientific progress and its applications;

> Each State party to the Covenant pledges itself to undertake progressively, with due regard to its organization and resources, the measures necessary to attain these objectives in all the territories within its jurisdiction.[105]

There was little debate on the provision in the Commission on Human Rights at its session ending in May 1951. Jacques Havet, speaking on behalf of UNESCO, said that '[t]he right of everyone to enjoy his share of the benefits of science was to a great extent the determining factor for the exercise by mankind as a whole of many other rights'.[106] He explained that '[e]njoyment of the benefits of scientific progress implied the dissemination of basic scientific knowledge, especially knowledge best calculated to enlighten men's minds and combat prejudices, coordinated efforts on the part of States, in conjunction with the competent specialised agencies, to raise standards of

living, and a wider dissemination of culture through the processes and apparatus created by science'.[107] The Commission adopted the Chilean draft with the exception of the final paragraph, which belonged in the general provisions of the treaty applicable to all economic, social and cultural rights.[108]

The previous December, the General Assembly had taken a decision to include economic, social, and cultural rights in the Covenant.[109] There was no unanimity about this, and a number of Western States were opposed.[110] In 1951 the Western States succeeded by a small majority with their demand for two Covenants, each with a different set of implementation instruments.[111] At its 1952 session, the Commission on Human Rights prepared the first draft of the International Covenant on Economic, Social and Cultural Rights. The United States proposed a text to replace the one adopted by the Commission the previous year:

1. The States Parties to the Covenant recognise the right of everyone:
   (a) To take part in cultural life;
   (b) To enjoy freedom necessary for scientific research and creation.
2. The full attainment of this right requires the conservation, the development and the diffusion of science and culture.[112]

Eleanor Roosevelt, who was then in her final year as a member of the Commission, explained that the United States had put the emphasis on 'the freedom necessary for scientific research and creation because the original text called merely for the right to enjoy the benefits of scientific progress, or, in other words, simply the right to enjoy the results of scientific research, whereas what was really required was to ensure conditions in which such research could be freely conducted'.[113] The American proposal was consistent with the position taken by UNESCO. Its Human Rights Committee, which had been shown an early draft of the American proposal, felt that in referring to 'the need for guaranteeing the freedom of the creative mind in scientific and intellectual research' the American proposal was a useful addition.[114]

Nevertheless, the elimination of the right to the benefits of science provoked criticism from some Member States. Venezuela's delegate insisted upon the point: 'In many countries, people were prevented from enjoying the benefits of scientific. discoveries and inventions because the latter were suppressed by powerful economic or political interests which were unwilling to make the capital investment required; it was necessary to ensure that such benefits were made available to all, without obstruction.'[115] Poland and Uruguay proposed amendments to the American amendment in order to revive the idea: '(c) To enjoy the benefits of scientific progress and its applications.'[116] Roosevelt agreed but 'on condition that it should not be interpreted as infringing recognised rights such as literary, artistic, scientific and commercial rights'.[117] The American resolution was reformulated so as to reinstate the phrase about the benefits of science.

1. The States Parties to the Covenant recognise the right of everyone:
   (a) To take part in cultural life;
   (b) To enjoy the benefits of scientific progress and its applications.

2. The steps to be taken by the States Parties to this Covenant to achieve the full realisation of this right shall include those necessary for the conservation, the development and the diffusion of science and culture.
3. The States Parties to the Covenant undertake to respect the freedom indispensable for scientific research and creative activity.[118]

It was adopted by 14 votes to none, with 3 abstentions.[119]

The Soviets had attempted to revive the clause on the objectives of science that they had proposed, without success, for the Universal Declaration of Human Rights by adding the words 'and to ensure the development of science and education in the interests of progress and democracy and of the maintenance of peace and cooperation between peoples'.[120] The Soviet delegate, Platon Morozov, argued that it was 'essential for States to take the steps necessary to prohibit scientific activity designed to destroy mankind'. He referred to nuclear science which had gone in two directions, one for peaceful purposes and the other for mass destruction of human beings.[121]

According to the Commission's Report, while 'some members' favoured the clause, '[m]ost members, however, were opposed to including à statement of the ends which scientific research should serve, on the grounds that scientific research by its nature was independent of any external criterion and that a statement of aims such as that envisaged might provide a pretext for State control of scientific research and creative activity'.[122]

The Commission draft of article 15 was debated in in the Third Committee of the General Assembly in 1957. UNESCO's representative, Rene Maheu, pointed to the difference between the provision on cultural rights then being debated and the two that preceded it, which concerned education. He noted that whereas the rights in articles 13 and 14 were already well-defined, article 15 'dealt with ideas which were still in the process of evolution, from both the legal and the philosophical points of view … Moreover, it dealt with matters in which the State, although playing a considerable part, could act only with great caution, since the very freedom of the human mind was involved.' Maheu said care should be taken to protect scientific freedom in order to prevent destroying the right that intended to be protected.[123]

Czechoslovakia revived the debate about the purposes of scientific research. It submitted a draft amendment proposing insertion of the words 'in the interest of the maintenance of peace and co-operation among nations' at the end of paragraph 2.[124] In the course of the debate, Czechoslovakia took up a suggestion from UNESCO's representative and added the words 'in particular' before 'in the interest of'.[125] The UNESCO representative was favourable to the Czechoslovak proposal on the purposes of scientific research. Maheu pointed to article 1 of UNESCO's Constitution which declared that education, science and culture were instruments of peace.[126] Czechoslovakia's representative said it was 'common knowledge, however, that, applied to the wrong ends, technical and scientific progress could be harmful to humanity'.[127] She noted that the paragraph on cooperation would be consistent with a General Assembly resolution adopted unanimously at the previous session and to a draft resolution on the same subject proposed by her delegation and adopted by the Third Committee earlier in the month.[128]

Greece objected to the words 'in the interest of the maintenance of peace and co-operation among nations', saying they were not only unnecessary 'but even dangerous'. Its delegate asked '[w]ho would be the judge?', explaining that '[i]In all likelihood, it would be the State, in which case the amendment would have the effect of restricting individual freedom'.[129] The United Kingdom was of the same view. '[S]cience and culture were autonomous in their very nature and could not be made subject, as regards their aims, to other principles, however admirable', said Samuel Hoare.[130] The Rapporteur observed that Czechoslovakia's addition of the words 'in particular' failed to satisfy those who objected to the proposal.[131] Czechoslovakia's amendment on peace and co-operation among nations was rejected by 35 to 21, with 16 abstentions.[132]

Czechoslovakia also proposed the addition of a fourth paragraph: 'The States Parties to the covenant will encourage all-round development of international scientific and cultural co-operation and of mutual contacts between scientific and cultural experts.'[133] After the United Kingdom questioned whether the new paragraph 4 should impose an obligation, Saudi Arabia thought the problem could be addressed by replacing the words 'States Parties will encourage' with 'States Parties recognise the benefits derived from the encouragement of…' Saudi Arabia also proposed replacing 'contacts between experts' with 'international contacts'.[134] Czechoslovakia accepted the amendments.[135] The new paragraph met with general approval and was adopted by 47 to 9, with 16 abstentions. The final text was adopted by 71 votes to none, with one abstention.[136]

Two years after adoption of the Covenant, the Proclamation of the International Conference on Human Rights reflected concerns about the abuse of science: 'While recent scientific discoveries and technological advances have opened vast prospects for economic, social and cultural progress, such developments may nevertheless endanger the rights and freedoms of individuals and will require continuing attention.'[137] Similar concerns appear in the Vienna Declaration which, after acknowledging the right to enjoy the benefits of scientific progress and its applications notes that 'certain advances, notably in the biomedical and life sciences as well as in information technology, may have potentially adverse consequences for the integrity, dignity and human rights of the individual'.[138]

Conclusions

General Comment 25, adopted by the Committee on Economic, Social and Cultural Rights in 2020, places a great deal of emphasis on participation in science. The issue of the direction that science should take, which was a preoccupation of the drafters of the two provisions, receives relatively little attention. The General Comment points to minor differences in terminology, noting that the Universal Declaration of Human Rights speaks of 'scientific advancement' while the Covenant refers to 'scientific progress'. The Committee makes no issue of the distinction and treats the two phrases as if they are synonymous: '[T]hese expressions emphasise the capacity of science to contribute to the well-being of persons and humankind. Thus, the development of science in the service of peace and human rights should be prioritised by States over other uses.'[139]

The consideration given in this essay to UNESCO's work on race during its early years may strike some readers as a digression from the subject of the right to science. But the

discussion seems justified because this was probably the first manifestation of UNESCO's engagement in the implementation of its human rights responsibilities which were framed by the terms of article 27(1) of the Universal Declaration of Human Rights. Unlike the Charter of the United Nations, which is silent on the specific subject of racial discrimination other than in the formulaic references to equality in general, the preamble of UNESCO's Constitution addresses the issue directly: 'That the great and terrible war which has now ended was a war made possible by the denial of the democratic principles of the dignity, equality and mutual respect of men, and by the propagation, in their place, through ignorance and prejudice, of *the doctrine of the inequality of men and races*'.[140]

UNESCO took up the issue of race in 1949 at the request of the human rights organs of the United Nations. Two statements were issued in the space of a few years, the work of teams of scientists from several disciplines belonging to both the social sciences and the natural sciences. In so doing, UNESCO was not proclaiming the right of scientists to conduct research without government involvement. Rather, it was imposing a framework for the direction of science, laying down, if only implicitly, guidelines for the direction that research should take. The UNESCO statements delivered a serious blow to so-called eugenics, which had been a favourite subject of Nazi 'scientists' but also one of interest to many researchers in other countries, including the first director general of UNESCO, Julian Huxley.

But even within the organisation, UNESCO's early statements on race seem afflicted with a degree of ambivalence. A recent study on science within the work of the organisation, comprised of detailed discussions of activities in mathematics, oceanography, geology, and engineering, to name a few contains a single perfunctory reference to the work on race.[141] The *UNESCO Courier* devoted a special issue to racism in 2001, in conjunction with the Durban Conference on racism and racial discrimination. A short chapter by Prof. George Frederickson entitled 'The rise and fall of the laboratory racist' refers to 'the scientific racism that had been respectable and influential in the United States and Europe before World War II' but inexplicably makes no mention of the UNESCO statements.[142]

René Cassin was an iconic personality in the development of international human rights law. As a founding member of the Commission on Human Rights, he was one of the authors of article 27(1) of the Universal Declaration of Human Rights. In 1972, Cassin published an article with the title 'Science and Human Rights'. Cassin's overriding concern was with the abuses of science. He acknowledged the tension between the freedom of the scientist in the conduct of research and her or his responsibility to serve humanity.[143] The challenge of 'dual use' confronts part of this issue.[144] But resisting applications of science that may cause harm is not entirely the same as insisting that science direct its attention to 'progress'. The spirit that inspired UNESCO in 1950 should be revived. It was a concrete manifestation of the application of science in the service of human rights.

The drafting histories of article 27(1) of the Universal Declaration of Human Rights and article 15(1)(b) reveal important tensions in understanding the scope of 'the right to science', as it is now called. The debate was generally focussed not on the beneficiaries of the right but rather on the scientists themselves. The view that the right was essentially about the freedoms of scientists to engage in research unencumbered by any political or

ideological orientation was promoted. However, article 15(3) of the Covenant clarifies the autonomy of this issue: 'The States Parties to the present Covenant undertake to respect the freedom indispensable for scientific research … '

The Soviets were the main promoters of the view that scientific research must pursue progressive aims. They were unsuccessful in their efforts to insert language along these lines in the two provisions. As they pointed out in the debates, there was an inconsistency with the recognition of such a perspective with respect to freedom of education. For example, in article 13(1) of the Covenant the States Parties affirm that 'education shall be directed to the full development of the human personality and the sense of its dignity, and shall strengthen the respect for human rights and fundamental freedoms. They further agree that education shall enable all persons to participate effectively in a free society, promote understanding, tolerance and friendship among all nations and all racial, ethnic or religious groups, and further the activities of the United Nations for the maintenance of peace.' Why should it be any different for science? Moreover, the failure to incorporate language making clear that not all science is beneficial to humanity is inconsistent with the activities of UNESCO at the time the right was being formulated, as its work on the fallacy of race makes clear.

Notes

1. Verbatim minutes of the closing plenary session, Opera House, 26 June 1945, (1945) 1 UNCIO 658, at p. 677.
2. *United States v. Brandt et al.*, Judgment, 19 August 1947, (1948) 2 TWC 183, at p. 183.
3. Mikel Mancisidor, 'The Dawning of a Right Science and the Universal Declaration of Human Rights (1941–1948)', in *The Right to Science, Then and Now*, ed. Helle Porsdam and Sebastian Porsdam Mann (Cambridge: Cambridge University Press, 2022), 17–32, at p. 20.
4. Inter-American Juridical Committee, Draft Declaration of the International Rights and Duties of Man and Accompanying Report, (1946) 40 *American Journal of International law Supp.* 93. The Draft Declaration was also produced as an official United Nations document: Draft Declaration of the International Rights and Duties of Man formulated by the Inter-American Juridical Committee, E/CN.4/2. It had been submitted to the first session of the General Assembly by Chile: Letter from the Representative of Chile to the Secretary-General, 3 November 1946, A/C.1/38.
5. For a detailed discussion of the drafting of the provision, see Cesare P.R. Romano, 'The Origins of the Right to Science, The American Declaration on the Rights and Duties of Man', in *The Right to Science, Then and Now*, ed. Helle Porsdam and Sebastian Porsdam Mann (Cambridge: Cambridge University Press, 2022), 33–53, at pp. 35–45.
6. Analysis of Various Draft International Bills of Rights, 23 January 1947, E/CN.4/W.16, p. 5; List of Types of Rights Contained in Drafts of Proposed International Bills of Rights, 31 January 1947, A/CN.4/W.18.
7. Draft Outline of International Bill of Rights (prepared by the Division of Human Rights), 4 June 1947, E/CN.4/AC.1/3, art. 44.
8. Drafting Committee on an International Bill of Human Rights, International Bill of Rights Documented Outline, 11 June 1947, E/CN.4/AC.1/3/Add.1, 356.
9. Summary Record of the 15th Meeting of the Drafting Committee of the Commission on Human Rights, 23 June 1947, E/CN.4/AC.1/SR.15, 3–4.
10. Report of the Drafting Committee on an International Bill of Human Rights: Suggestions for the Preamble of an International Declaration on Human Rights, 1 July 1947, E/CN.4/21, Annex E, 80–1.

11. Draft Charter of International Human Rights and Duties, Proposed by the Delegation of Ecuador, 12 November 1947, E/CN.4/32, art. 15 (emphasis in the original).
12. Summary Record of the 9th Meeting of the Working Group on the Declaration of Human Rights, 10 December 1947, E/CN.4/AC.2/SR.9, 2.
13. Ibid., 3–4.
14. Report of the Working Group on the Declaration on Human Rights, 10 December 1947, E/CN.4/57, 15.
15. Draft International Declaration on Human Rights, 16 December 1947, E/CN.4/77/Annex A, 8; Draft International Declaration on Human Rights, 17 December 1947, E/600, Annex A, 18.
16. France: Amendment to Article 30 of the Draft International Declaration of Human Rights, 11 June 1948, E/CN.4/126.
17. Summary Record of the 70th Meeting of the Commission on Human Rights, 11 June 1948, E/CN.4/SR.70, 4.
18. Ibid.
19. Ibid., 5.
20. Ibid., 4–5.
21. Ibid., 6.
22. Ibid.; Draft International Declaration of Human Rights, 18 June 1948, E/CN.4/148/Add.1, 4; Draft International Declaration of Human Rights, 28 June 1948, E/800, 13.
23. Statement Made by the Delegation of the Union of Soviet Socialist Republics, on 18 June 1948, in the Commission on Human Rights on the Results of the Commission's Work, 28 June 1948, E/800, Appendix, 44; Compilation of Amendments to the Draft Declaration of Human Rights Submitted to the Third Committee before 4pm 6 October in Chronological Order, 6 October 1948, A/C.3/230, 16; Recapitulation of Amendments to Article 25 of the Draft Declaration (E/800), 20 October 1948, A/C.3/302.
24. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 623–4.
25. Ibid., 620.
26. Ibid., 630.
27. Ibid., 622.
28. Summary Record of the 151st meeting of the Third Committee, 22 November 1948, A/C.3/SR.151, 628.
29. Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 636.
30. Ibid., 637.
31. Ibid., 635.
32. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 621; Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 637.
33. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 625. Also Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 637.
34. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 625. Also Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 636.
35. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 631–2.
36. Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 635.
37. Ibid.
38. Summary Record of the 151st meeting of the Third Committee, 22 November 1948, A/C.3/SR.151, 630–1.
39. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 619.

40. Cuba: Amendments to Articles 23 to 27 of the Draft Declaration (E/800), 12 October 1948, A/C.3/261; Recapitulation of Amendments to Article 25 of the Draft Declaration (E/800), 20 October 1948, A/C.3/302
41. Summary Record of the 150th meeting of the Third Committee, 20 November 1948, A/C.3/SR.150, 618.
42. Ibid., 619.
43. Summary Record of the 151st meeting of the Third Committee, 22 November 1948, A/C.3/SR.151, 630–27; China: Compromise text for Article 25 of the Draft Declaration (E/800), 22 November 1948, A/C.3/621.
44. Summary Record of the 152nd meeting of the Third Committee, 22 November 1948, A/C.3/SR.152, 635.
45. Jean-Jacques Renoliet, *L'UNESCO oubliée, la Société des Nations et la coopération intellectuelle (1919–1946),* Paris: Publications de la Sorbonne, 1999.
46. Gail Archibald, 'How the 'S' came to be in UNESCO', in Patrick Petitjean, Vladimir Zharov, Gisbert Glaser, Jacques Richardson, Bruno de Padirac and Gail Archibald, eds., *Sixty Years of Science at UNESCO 1945–200*5, Paris: UNESCO, 2006, 36–40.
47. The Grounds of an International Declaration of Human Rights (Report of the UNESCO Committee on the Philosophic Principles of the Rights of Man to the Commission on Human Rights of the United Nations), 31 July 1947, Phil./10, 1. On the preparation of this document, see Mark Goodale, ed., *Letters to the Contrary, A Curated History of the UNESCO Human Rights Survey*, Stanford: Stanford University Press, 2018.
48. Ibid., 6.
49. Ibid., 11.
50. Summary Record of the 26th Meeting of the Commission on Human Rights, 3 December 1947, 11–13.
51. Ibid., 16.
52. Communication Addressed by the United Nations Educational, Scientific and Cultural Organization to the Chairman of the Commission on Human Rights, 16 December 1947, E/CN.4/78.
53. For example, Verbatim record of the 69th Meeting of the Economic and Social Council, 14 March 1947, E/422. 1–2; Summary Record of the 8th Meeting of the Working Group on the Declaration of Human Rights, 10 December 1947, E/CN.4/AC.2/SR.8, 5; Summary Record of the 40th Meeting of the Commission on Human Rights, 16 December 1947, E/CN.4/SR.40, p. 13; Summary Record of the 67th Meeting of the Commission on Human Rights, E/CN.4/SR.67, 10 June 1948, 11; Summary Record of the 68th Meeting of the Commission on Human Rights, E/CN.4/SR.68, 10 June 1948, 3, 6.
54. Summary Record of the 9th Meeting of the Working Group on the Declaration of Human Rights, 10 December 1947, E/CN.4/AC.2/SR.9, 2.
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56. W.A. Noyes, 'Science and the rights of man', in *Human rights, Comments and appreciation*, UNESCO/PHS/3(rev.), 25 July 1948, 221–4.
57. Report submitted to the Commission on Human Rights, 6 December 1947, E/CN.4/52, 17. The proposal was endorsed without change by the Commission on Human Rights: Report of the Commission on Human Rights, Second Session, Geneva, 2 December to 17 December 1947, E/600, para. 35.
58. Report of the Second Session of the Economic and Social Council, 1–2 March 1948, E/RES/116 (VI) B, para. B(iii).
59. Note on implementation of Resolution E/RES/116 (VI) B, 9 May 1949, E/CN.4/173, 4–6.
60. Records of the General Conference of UNESCO, Fourth Session, 1949, 22.
61. Arthur Ramos, 'The Question of Race and the Democratic World', *International Social Science Bulletin* 1, no. (3–4) (1949): 1, at p. 10.
62. Committee of Experts on Race Problems, Implementation of the Resolution of the Economic and Social Council, 7 December 1949, UNESCO/SS/Conf.1/2.

63. See Frazier's magnum opus, *Black Bourgeoisie*, New York: Macmillan, 1962. Also Anthony M. Platt, *E. Franklin Frazier Reconsidered*, New Brunswick, N.J.: Rutgers, 1991. For a critical assessment of the individual views of the Committee's members, see Sebastían Gil-Riaño, 'Relocating Anti-racist Science: The 1950 UNESCO Statement on Race and Economic Development in the Global South', *British Journal for the History of Science* 51 (2018): 281.
64. UNESCO/SS/Conf.1/SR.1, 4.
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66. UNESCO/SS/Conf.1/SR.1, 7.
67. Ibid., 8.
68. For example, M.F. Ashley Montagu, 'The Genetical Theory of Race, and Anthropological Method', (1942) 44 (n.s.) *American Anthropologist* 369.
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78. William B. Fagg, Letter to the editor, *The Times*, 24 July 1950.
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80. William C. Osman-Hill, 'UNESCO on Race', *Man* 51 (1951): 16, as was pointed out by Prof. Don J. Hager of Princeton University in a letter to Alfred Métraux, 21 January 1951, UNESCO Archives 323.12 A 102 (Part II). See also Hager's reply to the letters by Osman-Hill and Vallois, 'Race', *Man* 51 (1951): 53.
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Anticipatory co-governance for human rights to sciences across knowledge systems

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ABSTRACT

The interface between Indigenous and Western knowledge systems highlights the existence of diverse sciences, each with their own history, contexts and processes for validation, with relevance to the human rights to sciences (HRS). The lens of intersectional universality shows how Indigenous peoples differ in ways that affect the HRS, through: (1) holding unique connections to territories, distinct cultures, worldviews and knowledge systems; (2) experiencing dispossession of their lands, territories and resources leading to great disadvantage in socio-economic status; (3) bearing a disproportionately high impact from colonial scientific practices that breach human rights; and (4) utilising Indigenous governance systems based on customary institutions for decision-making. Human rights law requires that these institutions are consistent with principles of non-discrimination – the universal aspect. From this recognition of difference and sameness, we argue that diligent anticipation of risk needs to be based on recognition and support from states for the institutions that govern Indigenous sciences, redress by relevant scientific organisations for the negative impacts of colonial scientific practices, and capacity-building to overcome inequitable distribution of resources and power. Anticipatory co-governance with Indigenous peoples can empower Indigenous agency, Indigenous perspectives on human rights and provide a fertile ground for future thinking to diligently anticipate risks and benefits of science and scientific progress.

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Introduction to the anticipation of risk and benefit in the human rights to sciences

The United Nations' (UN) Universal Declaration of Human Rights (UDHR) and International Covenant on Economic, Social and Cultural Rights (ICESC) recognise the human rights to science (HRS). Article 15(1b) of the ICESC sets out everyone's right to enjoy the benefits of scientific progress and its applications. Current global circumstances highlight the potential benefits of science, including Western and Indigenous

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sciences, in understanding and responding to numerous global challenges that affect human health and wellbeing including climate change, pandemics and biodiversity loss.[1] On the other hand, the interface between Western scientific and Indigenous knowledge systems has often been characterised by grave human rights abuses, include living Indigenous people being collected and displayed in zoos, theft of human remains and cultural objects, and removal and exploitation of Indigenous knowledge of medicinal plants.[2] As a result of this context, Indigenous people encounter unique challenges in anticipating the benefits and risks associated with the HRS.

The aim of this article is to examine the content, scope and bearers of the various duties and responsibilities to diligently anticipate the potential risks and benefits of the HRS, taking account of the interface between Indigenous and Western knowledge systems. The term 'Indigenous knowledge systems' refers here to cumulative bodies of knowledge, practices and beliefs, evolving by adaptive processes and handed down and across generations by cultural transmission within diverse Indigenous societies.[3] 'Western knowledge systems' similarly refers to knowledge, practices and beliefs, arising in western European countries and consolidated in post-Renaissance Europe on the basis of wider and more ancient roots, and which have now spread across the globe.[4] I investigate this interface from the standpoint of a non-Indigenous environmental scientist who has worked at that interface for some decades [see Mclean et al.[5] for a useful discussion of positionality in this context]. My perspective aligns with Sen's[6] position that human rights are pronouncements in social ethics, sustainable by open public reasoning, whether or not they are reflected in legislation or other normative formats. Public reasoning necessarily occurs across cultures, with diverse worldviews and perspectives about what constitutes human rights, and thereby across diverse knowledge systems – hence consideration of the interface between Indigenous and scientific knowledge systems is important.

States have duties under the UN frameworks to anticipate both the risks and the benefits of science and scientific progress. Here I argue that Indigenous peoples, now frequently recognised as First Nations although not nation-states, also hold duties to diligently anticipate the risks and benefits of science, internationally under the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Care is required to understand how these duties and responsibilities arising from collective human rights under the UNDRIP can be structured and implemented in ways that are consistent with, rather than in conflict with, the HRS.[7] The article begins with a description of the interface between Indigenous and Western knowledge systems and sciences, followed by a discussion of how intersectional universality provides a means to identify difference/similarity and navigate potential conflicts between UNDRIP and the HRS. I then provide a brief overview of the impacts of human rights breaches by Western scientific practices on Indigenous peoples, and the beginning of initiatives by scientific organisations to provide redress, with some examples. I consider examples of benefits arising from Western science and technology (i.e. derivatives of scientific progress) for and with Indigenous peoples, and identify mechanisms and conditions that made this possible, including capacity building. The final section sets out how anticipatory co-governance at both national (domestic) and international levels can underpin pathways to diligent anticipation of the risks and benefits of science relevant to the HRS consistent with the UNDRIP, and is followed by concluding comments.

The interface between Indigenous and Western knowledge systems and sciences

In 2020, guidance was published on working across Indigenous, local and scientific knowledge systems for assessments in the context of the global intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES).[8] This guidance built on conceptualisations of the value of a multiple evidence base (MEB), drawing together an enriched picture from knowledge systems based on distinctive world views.[9] Each knowledge system has its own history, context and methods for validation of knowledge claims[10] (Figure 1a). The MEB framework provides effective practices for crossing the boundaries between knowledge systems in ways that take account of historical injustices and power imbalances, without privileging Western over Indigenous science.[11] Practices of expecting rights, supporting care and mutuality, strengthening Indigenous peoples and local communities (IPLC) and their knowledge systems and supporting effective knowledge exchange dialogues, have proved an effective interface of knowledge systems in biodiversity assessments.[12]

Nevertheless, Indigenous and Western scientific knowledge systems share many commonalities as well as distinct differences. 'Western scientific knowledge systems' is a short-hand term for a body of work which is mostly characterised by cross-fertilisation and exchange, and during the colonial era – which continues today – by theft, oppression and what appears as extreme cruelty.[13] A recent history of sciences has demonstrated that the first recorded botanical garden in the world was established by the Aztec rulers in the ancient city of Tenochtitlan (now Mexico City). Encounters between Indigenous peoples and Western scientists were foundational in the establishment of botanical gardens

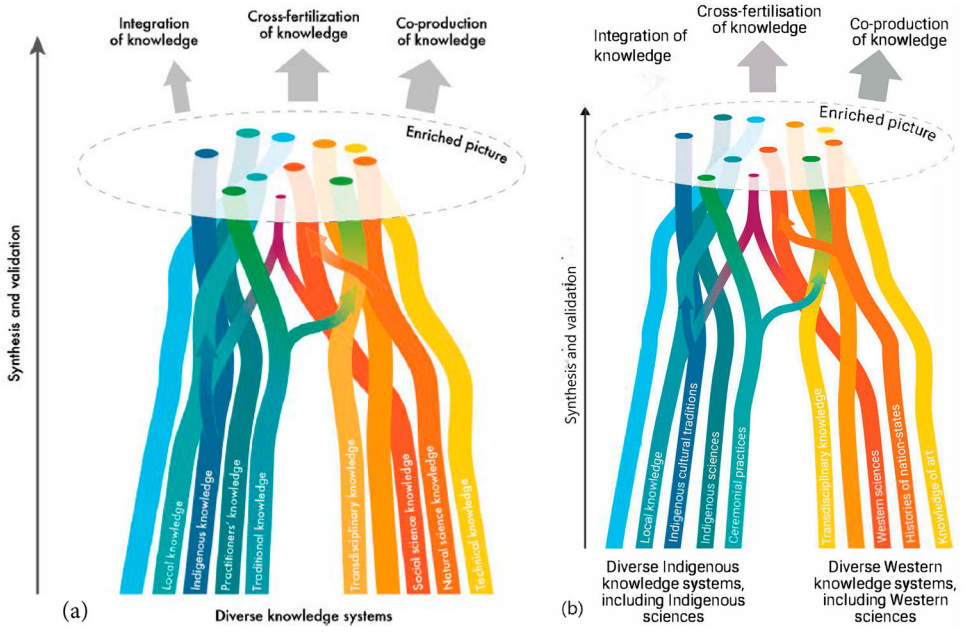

Figure 1. Encounters across diverse knowledge systems with sciences embedded in them. Adapted from Tengo et al. 2014.[82]

across Europe.[14] Copernicus, often hailed as the founder of the scientific revolution, drew on Islamic texts taken to Italy after the Ottoman conquest of Istanbul, and their astronomical measurements, to formulate his model of the planetary movements.[15]

The UNDRIP identifies that Indigenous people consider their own knowledge to include 'sciences' (see Article 31). The definition of science provided by the CESCR[16] for interpretation of the HRS (Box 1) is certainly broad and inclusive of cultural diversity in the sciences. Indigenous peoples in diverse states are asserting a history of scientific endeavours. For example, in Australia, recent publications promote Australia's Indigenous peoples as the 'first scientists'.[17] School curricula link Western science with this Indigenous scientific knowledge.[18] In the USA, a group of First Nations scientists released a statement prior to the 2017 March for Science setting out their perspective that there is more than one 'science' and their Indigenous cultures include sciences, while giving different emphases to aspects of the scientific process than those of Western sciences.[19] Figure 1b highlights recognition in this article of an encounter across Indigenous, Western and other knowledge systems (*sensu* Tengo et al. 2014[20]) each with sciences embedded in them.

Box 1. Definition of science provided by CESCR[21] for interpretation of the HRS.

'Science' signifies the enterprise whereby humankind, acting individually or in small or large groups, makes an organized attempt, by means of the objective study of observed phenomena and its validation through sharing of findings and data and through peer review, to discover and master the chain of causalities, relations or interactions; brings together in a coordinated form subsystems of knowledge by means of systematic reflection and conceptualization; and thereby furnishes itself with the opportunity of using, to its own advantage, understanding of the processes and phenomena occurring in nature and society … 'the sciences' signifies a complex of knowledge, fact and hypothesis, in which the theoretical element is capable of being validated in the short or long term, and to that extent includes the sciences concerned with social facts and phenomena.

Figure 1a and b continues to highlight that each knowledge system, and the sciences embedded in them, have their own processes for validation, for determining what is true.[22] The sharing of knowledge is determined by rules innate to each knowledge system – for example, among many Australian First Peoples, according to their customary knowledge protocols, some Indigenous information can only be shared in certain places, and only with certain people.[23] Article 31 of the UNDRIP sets out the rights of Indigenous peoples to 'maintain, control, protect and develop their cultural heritage, traditional knowledge, and traditional cultural expressions, as well as the manifestations of their sciences'. Among many Indigenous societies, sharing of knowledge is not a right nor a responsibility.[24] Protection of Indigenous cultural and intellectual property is a key priority.[25] This collective right to control manifestations of their sciences under the UNDRIP is potentially in conflict with the HRS, which recognises the rights of everyone to participate in science, access and enjoy the benefits of science, and be protected against the adverse effects of science.

Intersectional universality at the interface between knowledge systems

Universality is a foundation of all human rights law – as set out specifically in the Universal Declaration of Human Rights: 'all human beings are born free and equal in dignity and rights and that everyone is entitled to all the rights and freedoms set out therein, without distinction of any kind, in particular as to race, colour or national origin'.

Why then do Indigenous peoples have rights to control access to their sciences under the UNDRIP, when the HRS calls for universal accessibility?

Intersectionality provides insight into this tension, noting that human beings are highly diverse. People differ individually in terms of gender, age, access to material resources and education; and differ as groups, for example in terms of their languages, identities, cultures, histories and religions.[26] Intersectionality's prime concern has been on the interactions of multiple causes of oppression, for example as a result of both ethnicity and gender.[27] More recently, the potential for strategic intersectionality has emerged, whereby oppressed actors gather agency from multiple identities, and increase their power to navigate and challenge multiple structures of discrimination through coalitions and solidarity.[28] Intersectional universality posits that human rights must be understood simultaneously in terms of sameness and difference – both in their fundamental workings and also in how they are realised or violated.[29]

Indigenous peoples' differences are important in considering the HRS. While an official definition of 'Indigenous' has not been adopted by the UN, Indigenous peoples typically self-identify as Indigenous, and are accepted by their community as a member of societies often with historical continuity with pre-colonial and/or pre-settler societies now occupying the same territory.[30] Indigenous peoples have strong links to territories and distinct cultures, beliefs, world views, political and knowledge systems. Indeed, Indigenous peoples have the right to belong to a community or nation in accordance with their traditions and customs (UNDRIP Article 9) and to maintain and develop their collective decision-making institutions (UNDRIP Article 18).[31] Indigenous peoples also share common experiences of dispossession of their lands, territories and resources, which have resulted in great disadvantages in socio-economic status. Even many years since adoption of the UNDRIP by the UN General Assembly in 2007, there is little respite from the violations of human rights experienced in Indigenous peoples' legitimate struggles to protect their lands, resources, livelihoods and cultures.[32] Indigenous peoples have faced multiple and ongoing challenges to maintaining their sciences from external forces wielded by other groups, including states and scientific organisations.[33] These differences provide Indigenous peoples with their own unique perspectives on what constitutes HRS, and particular Indigenous peoples' rights to Indigenous sciences.

The colonial expansion heralded a time of great suffering for the original inhabitants of many lands, some of which was directly at the hands of colonial science. Relationships of domination and subordination characterise colonial science.[34] Many scientific practices breach rights recognised under the UNDRIP. Examples include living Indigenous people being collected and displayed in zoos, theft of human remains, cultural objects, and fossils, removal and exploitation of Indigenous knowledge of medicinal plants, and ongoing 'parachute' science activities – thereby breaching at least Articles 7, 11, 24 and 31 of the UNDRIP (Table 1). Indigenous peoples bear a disproportionate share of negative impacts of colonial scientific practices that breach human rights.

Some ways forward to redress this legacy, prevent its ongoing occurrence and build collaboration between Indigenous peoples and scientific organisations are beginning to emerge. For example, the Africa Museum in Belgium curated an exhibition in 2021 to highlight the truth of their (and others') 'human zoo' exhibitions that led to tragic deaths,[35] although issues of reparation have not been addressed. A global movement

Table 1. Negative impacts of scientific practices on the human rights of Indigenous peoples, with current ways forward to redress this legacy.

UNDRIP clauses and negative impacts of scientific practices (UNDRIP clauses)	Specific example	Ways forward
Rights to life free of violence (Article 7). Living Indigenous peoples captured and exhibited in zoos	Head of the New York Zoological Society arranged for a Congolese Indigenous person to be displayed at Bronx Zoo in 1906. Similar examples from numerous countries[83]	Zoos and scientific societies examine their history to enable truth-telling[84] and work with the relevant Indigenous peoples to negotiate redress and reparation
Protection from the removal of human remains (Article 7, 11). Burial sites robbed of human remains for scientific collections	The National Museum of Australia holds the remains of more than 700 Indigenous people, most returned from overseas scientific collections[85]	Repatriate remains to communities where possible; collaborate with Indigenous people to establish appropriate resting places where repatriation is impossible[86]
Protection from removal of cultural objects without Free, Prior and Informed Consent (FPIC) (Article 11)	British Museum holds an extraordinary collection of objects taken from Australian Indigenous Peoples without FPIC.[87] Vast collections of Indigenous artefacts are held in museums across the world.	Repatriate cultural objects,[88] link artefacts to Indigenous people where return is not possible,[89] supporting Indigenous-led cultural heritage research and curation[90]
Protection from the removal of fossils (Article 11).Archaeological sites robbed, local communities/scientists excluded from studying them through cultural/structural discrimination	Publications on Jurassic–Cretaceous fossils from NE Brazil over the last three decades include several studies based on fossils illegally reposited in foreign collections, particularly in Germany and Japan[91]	Keep fossils in the country/places of origin, acknowledge history, equitable, reciprocal partnerships that develop in-country expertise, participatory and Indigenous-led research, FPIC processes[92]
Rights to traditional medicines and control of knowledge (Articles 24, 31). Knowledge of medicinal plants recorded by scientists who then have ownership	Aztec/Mayan knowledge of plants recorded by colonial scientists; publications (Codex) largely destroyed and remaining ones held in overseas collections[93]	Collaboration to return knowledge to communities[94]; legal changes to recognise the prior ownership by Indigenous peoples of their Indigenous Cultural and Intellectual Property (ICIP); application of the Nagoya Protocol going forward
Right to control and develop manifestations of their sciences (Article 31). 'Parachute science' removes control of Indigenous peoples' sciences	'Parachute science' occurs when scientists from non-local agencies conduct research or deploy programmes and fail to invest in, fully partner with, or recognise local governance, capacity, expertise, and social structures[95]	Decolonise science through supporting Indigenous-led initiatives, mutually beneficial partnerships and knowledge co-production[96]

for repatriation from scientific collections of human remains[36] and cultural objects[37] is under way. Some progress is occurring in terms of Indigenous-led heritage science and partnerships between Indigenous and Western science in curating and displaying scientific collections.[38] Recent outrage over the ongoing colonial approach to collection of fossils has triggered interest in decolonising palaeontology.[39] New methods for protection of Indigenous cultural and intellectual rights from exploitation of Western scientists are gaining traction[40] (Table 1). These initiatives are examples of what Porsdam and Porsdam[41] refer to as 'science diplomacy from within', whereby scientists and scientific organisations have taken responsibility to mediate in a divisive issue, regardless of the policy position of state actors in this domain, or scientists' lack of legally-defined roles as duty-bearers under the HRS.

Free, prior and informed consent from Indigenous peoples for participation in and access to their sciences from those outside the Indigenous community, such as scientific

organisations, is emerging as a foundational premise in these ways forward. CESCR in its General Comment No. 21 on the UNDRIP[42] notes that state parties should respect the principle of free, prior and informed consent (FPIC) of Indigenous peoples in all matters covered by their specific rights, including the rights over manifestations of their sciences. The UN Permanent Forum on Indigenous Issues (PFII) advises that 'free' means without coercion, 'prior' means before any activities are started, 'informed' requires that information be accessible, accurate and in a language able to be understood, and 'consent' requires that Indigenous peoples participate in decision-making using their own freely chosen representatives and customary or other institutions.[43] Where Indigenous peoples have given FPIC for release of their scientific knowledge into the broader public arena, the principles of the HRS regarding accessibility can fully apply. This condition is similar to the Western scientific processes of peer review and publication before research results are considered science that should be broadly accessible. States have a duty to put in place a framework that supports both Western and Indigenous scientific activities of peer review and FPIC through funding relevant organisations, and training for Western and Indigenous scientists.[44]

For Indigenous peoples inside communities involved in FPIC to release their scientific information, the UNDRIP also sets out (Article 34) that any decision-making institutions must function 'within international human rights standards' and therefore not practice discrimination based on gender, age or other categories of difference. Here is where we encounter the 'universal', the ways in which Indigenous peoples are the same as all peoples. This sameness does not, however, imply that all Indigenous knowledge should therefore be available to all people or all members of an Indigenous community – Indigenous peoples maintain that adherence to their own diverse knowledge protocols under their diverse customary laws are vital for knowledge sharing. For example, some knowledge can only be shared with people who hold specific rights to traditional territories, other knowledge can only be shared through special ceremonies, and following such knowledge protocols is regarded by them as vital for Indigenous peoples' cultural safety and obligations.[45] The Indigenous institutions that determine these rules do, however, need to operate in accordance with international human rights standards with each community, and ensure equality of opportunity for decision-making about FPIC. In practice, evidence is growing that implementation of the UNDRIP is strengthening democracy and equality, showing that diverse collective units with different identities can equally participate in the governing institutions under which they live.[46] States therefore have a duty to ensure that their frameworks support participation in such Indigenous scientific practices through funding, training and activities that engage Indigenous individuals from the relevant groups in fulfilling their responsibilities within these scientific institutions.

Navigating the benefits of sciences across knowledge systems

The negative impacts and legacies of Western scientific practices that breach human rights summarised above contribute in part to the notable marginalisation of Indigenous peoples from science-derived technologies that may be of benefit. For example, Native Hawaiians and other Pacific Islanders' lower rate of uptake of COVID-19 vaccines is associated with a distrust of official sources of information, not their cultural

background.[47] This distrust exacerbates social and economic factors that have led to a disproportionate impact of the COVID-19 pandemic on Indigenous peoples, including inequalities and exclusions from employment, lack of access to basic services including water and energy, educational disadvantage, and loss of access to land, territories and traditional knowledge.[48]

The World Health Organization's recently announced plan for a 'vaccine hub' is an important initiative to overcome barriers to vaccine access in the developing world. Undoubtedly, implementation of the HRS in this context of Indigenous disadvantage requires addressing issues of inequitable distribution of resources and power.[49] The health equity framework illuminates how implementation of human rights in the health domain is influenced by the historical and life course trajectory and by systems of power (policies/practices) that determine access to resources and opportunities, as well as the more familiar individual, physiological and social factors.[50] While policies broadly across social, economic, cultural and environmental domains are required to overcome persistent disadvantage, specific capacity-building actions are vital to overcome distrust of official sources of information in science, technology, engineering and maths (STEM).

In Australia, for example, 'Two-Way Science' education that links the Indigenous sciences with Western sciences in school programmes has proved successful for increasing engagement by Indigenous peoples in STEM.[51] Scholarships and support are critical for Indigenous people in STEM to study at undergraduate and postgraduate levels at university. Australia's national science agency is implementing an Indigenous Science Program based on recognition and respect for Indigenous sciences and people, together with employment and training strategies and a commitment to deep community engagement.[52] Deep community engagement in turn is underpinned by principles of transparency; iterative, community level, free prior and informed consent; and the sharing of power through the co-development of science and technology.[53]

On the other hand, Indigenous peoples are moving beyond FPIC as the foundation enabling co-existence between both individual and collective human rights, and discovering their own ways to benefit from Western science-derived technologies, usually with support of non-Indigenous allies (Table 2). For example, Indigenous-led research has demonstrated how co-developed protocols helped navigate potential tensions around the use of drones for landscape monitoring.[54] Indigenous content creators and developers are using digital and online technologies for revitalisation of languages.[55] Epidemiology for and with Indigenous peoples is providing ways around the barriers posed by distrust and inequities.[56] Indigenous data sovereignty has established new CARE principles (Table 2) to ensure that big and open data sets can be used by Indigenous peoples in beneficial ways.[57] Co-production across knowledge systems has demonstrated how Western scientific knowledge can be made available to Indigenous peoples through presentations by community members in their local languages.[58]

These examples (Table 2) show that a range of mechanisms, all underpinned by Indigenous peoples' agency, leadership and governance, are important for delivering the potential benefits: co-produced protocols, knowledge co-production, Indigenous methodologies, Indigenous cultural governance, a critical lens on colonial practices and deeply respectful partnerships. Thus an appreciation of differences between Western and Indigenous sciences allows mutually respectful collaboration that enables navigation

Table 2. Examples of beneficial use by Indigenous people of Western science-derived technologies and key mechanisms for benefits.

Western science-derived technology	Example of beneficial use by Indigenous peoples	Key mechanisms
Aerial drones	Used in monitoring biocultural landscape of in northern Australia's Kakadu National Park	Co-developed protocols[97]
Digital and online technologies for Indigenous languages	Review highlighting numerous Indigenous-led online sites and Indigenous coders working on language revitalisation	Indigenous socio-technological self-determination, Indigenous content creators, developers, and visionaries are becoming increasingly visible and influential[98]
Epidemiology using quantitative and statistical methods to document health concerns	Epidemiology for and by Indigenous people is an emerging field globally	Indigenous methodologies, Indigenous-centred courses, linkages with communities, countering racialised stereotypes, critical lens on colonial practices[99]
Big data (largely digital data sets held by governments/international organisations) and open data (free public access)	The Global Indigenous Data Alliance highlights how Indigenous data sovereignty can support Native Nation rebuilding (https://www.gida-global.org/)	CARE principles – collective benefit, authority to control, responsibility and ethics – sit alongside the FAIR principles – findable, accessible, interoperable, reusable[100]
Adaptation to climate change impacts	Co-production between local Arrente people of central Australia and scientists of knowledge about climate change, including a presentation in Arrente language	Respectful partnerships, cultural governance, Indigenous connection to traditional territories, a relationship with the nation-state that empower local decision-making, not central control[101]

of key challenges. A final important difference of Indigenous peoples, relevant to the HRS, is that they hold their own governance systems, based on unique customary institutions – their rights to maintain and develop these institutions are protected under the UNDRIP.

Anticipatory co-governance to identify risks and benefits in the context of diverse sciences

Anticipatory governance is gaining recognition as a key way forward to consider risks and benefits in complex situations such as that posed by the HRS.[59] Anticipatory governance refers here to a diverse set of practices of producing, contesting and analysing social constructions of what the future might look like in order to pre-emptively respond to potential negative outcomes.[60] Initiatives like the European Union's Responsible Research and Innovation (RRI) programme guide anticipation of risk in science and technology[61] through production and practices of norms. However, anticipation can also be based on democratic processes, aimed at identifying values and perspectives on which anticipatory governance needs to be anchored.[62] Such processes can mobilise the strength of intersectional universality to recognise differences in the context of colonial histories, governance systems and encounters across diverse sciences.

Science and technology-induced risks can be anticipated through various future thinking techniques such as scenarios, creating future visions, planning and strategic foresight.[63] Democratic processes of anticipation bring to the fore questions of whose visions are articulated in anticipation processes, what kind of futures they point to and how these visions have implications for actions in the present. Pluralistic future thinking

processes, which recognise the diversity of worldviews and perspectives about the future, can support intersectional universality in the anticipation of risk and benefit.[64] Participatory processes, whereby power about decision-making in future thinking for anticipation of risk and benefit is equitably shared between stakeholders and rightsholders, help support pluralistic anticipation across knowledge systems.[65] Indeed, participation rather than governance by Indigenous peoples is emphasised in General Comment 25 of the Committee on Economic, Social and Cultural Rights.[66]

The mechanisms identified above (Table 2) that enable benefits to derive from science and technology have at their core Indigenous peoples' governance. In this context, participation falls short, as it implies the relevant duty holders, states, reaching out to engage Indigenous peoples in their processes of anticipation, rather than a state-based governance to Indigenous people-based governance relationship. In order to address the different contexts of Indigenous peoples, engagement activities need to be designed, conducted and analysed in ways that confront longstanding power imbalances and enable Indigenous governance to be empowered.[67] Anticipatory co-governance with Indigenous peoples provides for recognition of shared duty and power to utilise tools such as knowledge co-production, protocols and Indigenous methodologies to better understand risks and benefits, and account for different perspectives on the HRS.

Co-governance with Indigenous peoples in the anticipation of risks and benefits underpins many of the successful initiatives described above (Table 2). For example, the co-developed protocols to manage the risks and benefits of drone technology occurred at Kakadu, a co-governed National Park in northern Australia. The project was overseen by the Kakadu Indigenous Research Committee, with representatives from all the major Indigenous clan and language groups in the region. Outside contexts of territorial co-governance, anticipatory co-governance with Indigenous peoples is currently best developed in the field of climate science, as key state and international actors begin to appreciate the governance value of Indigenous knowledge.[68]

The Great Barrier Reef Foundation in Australia, for example, is currently undertaking a participatory scenario exercise supporting Traditional Owners to develop their own visions of how to anticipate and respond to climate change impacts, and then to bring these together with technologically driven anticipation and innovation (e.g. building shades on the reef). Among Māori Indigenous peoples in New Zealand/Aotearoa many of their land- and ocean-based resources are governed through Māori-specific authorities, whose focus on community planning has identified the need to strengthen institutional capacity to anticipate risks.[69] A Māori Climate Platform is now being developed in partnership between the national government and the National Iwi (tribal groups) Chairs Forum who have established an eight-member (all Māori) Ministerial Advisory Committee to design the platform during 2023, with an intention for launch in 2024.[70] This platform is intended to support collaborative leadership of the anticipation of risk. At the global level, the Local Communities and Indigenous Peoples Platform, established under the United Nations Framework Convention on Climate Change, seeks to facilitate the incorporation of Indigenous knowledge into the states' anticipation and response processes.[71]

Many international organisations (IOs) are involved in different forms of anticipatory governance, including the International Labour Organization (ILO), the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development

(OECD), the United Nations Institute for Disarmament Research (UNIDR) and the United Nations Education, Scientific and Cultural Organisation (UNESCO).[72] These efforts have the potential to be enhanced by anticipatory co-governance with Indigenous peoples. The UNIDR, for example, is currently involved in activities to anticipate the risks of autonomous weapons systems (AWS). Experiences of the destructive power of nuclear weapons (currently lacking for AWS) are credited with driving the treaties to ban such weapons.[73] However, these atomic weapon experiences disproportionately affected Indigenous peoples – all of the main sites where over 500 atomic weapons were tested between 1945 and 1980, except one (the Monte Bello islands), were on Indigenous peoples' territories.[74] People have returned to live at Enewetak (Marshall) Atoll after 67 atomic tests, but are unable to eat the food and depend on quarterly food supplies from the government of the USA.[75] In the absence of direct experiences of the impacts of AWS, UNIDR is supporting the development of anticipatory norms through assembling knowledge from experts, translating complex information to make it more available, and representing this information to states, inviting them to imagine creatively how AWS could render both risks and benefits.[76] A turn towards co-governance with Indigenous peoples in this context could be supported through dialogue between the 16 members of the UN Permanent Forum on Indigenous Issues (UNPFII) and the 14 members of the Board of Trustees of the UNIDR to co-design the assembly, translation and representation of information about AWS to Indigenous peoples (as well as states). Such co-governed processes of norm-development would take account of Indigenous sciences and perspectives on human rights, and help avoid future disproportionate impacts of vulnerable Indigenous (and other) populations.

Anticipatory co-governance with Indigenous peoples at both national and international levels also needs to counter the influence of market and other exclusionary forms of governance. Potatoes are a prime example of a genetic resource that has been stewarded by Indigenous peoples of the Andes for millennia under local common property resource regimes – but continue to be regarded by some as a global commons, without boundaries. Beumer et al.[77] recently investigated how corporate-based and commons-based modes of governance of genetic resources may both shape the future of hybrid potato breeding. They concluded that to fully reap the benefits of this innovation requires (global) commons-based modes of governance.[78] By way of contrast, the original Indigenous stewards of the genetic diversity in the Potato Park of the Andes approach innovation with three focuses: (1) mutual reciprocity among human and non-human nature, (2) a collective deliberation process, and (3) ecological boundaries.[79] Anticipatory co-governance could enable a future that navigates differences in understanding of what constitutes innovation and enables mutual benefits from both local and global forms of common property resource regimes.[80]

Co-governance of the anticipation of risks and benefits requires sharing power in the decision-making process – power over whose visions are articulated, what kind of futures they point to and how these visions have implications for actions in the present. This type of co-governance can support the open public reasoning in a cross-cultural context that enables the institutions (and associated organisations and their representatives) that manage both Indigenous and Western scientific knowledge systems to consider anticipation of risk and benefit. This is not simply about making sure one or two Indigenous people are able to speak at a forum otherwise designed through Western norms. Rather, I

refer here to the sorts of co-designed dialogues championed by SwedBio – for example, their collaborative 'Dialogue across Indigenous, Local and Scientific Knowledge Systems Reflecting on the IPBES Assessment on Pollinators, Pollination and Food Production' which was supported by UNESCO and other agencies.[81] The UNPFII could be a useful body to initiate open public reasoning among diverse Indigenous peoples, their perspectives on the HRS, and their diverse sciences, and to co-host such a dialogue across diverse scientific knowledge systems.

Conclusion

Consideration of the anticipation of risks and benefits of science from this perspective of the interface between knowledge systems highlights several implications for guidance on implementation of the HRS. Application of the principles of intersectional universality enables a focus on how Indigenous peoples are both different and the same under the HRS. First, Indigenous peoples differ in their strong links to territories, frequently based on millennia of occupation, and distinct cultures, beliefs, political and knowledge systems that include diverse sciences. This difference highlights the need for recognition and respect for these diverse Indigenous sciences, alongside respect for Western and other scientific systems, and the duty of states to provide a framework that supports diverse sciences. Second, Indigenous peoples share disproportionately in negative impacts of colonial Western scientific practices that have breached their human rights, including for example through becoming living collections displayed by scientific organisations. This difference requires a focus on ending colonial scientific practices, and supporting redress and reparation by scientific organisations, a process which has begun in several organisations across the world. Third, Indigenous people face great disadvantage in terms of inequalities and exclusions from employment, lack of access to basic services including water and energy, educational disadvantage, and loss of access to land, territories and traditional knowledge. This difference requires specific attention to capacity building for Indigenous communities and individuals to engage in science.

Finally, Indigenous peoples have their own governance systems, and display agency and leadership in navigating the potential benefits and risks of science, taking account of their own perspectives on the HRS. This difference is leading to examples of co-governance in the anticipation and management of risks and benefits. Such co-governance arrangements operate on the same foundation – that all decision-making institutions need to be consistent with universal human rights, and free from discrimination based on gender, ethnicity, race or other categories. Anticipatory co-governance arrangements between states and Indigenous peoples, among international and domestication organisations, can provide a fertile ground for the types of future thinking that will diligently anticipate risks and benefits.

This examination of the content, scope and bearers of the various duties and responsibilities to anticipate risks and benefits of science highlights the existence of multiple sciences embedded in diverse knowledge systems and therefore of multiple duty holders. States hold duties to support the cultural norms and protocols that govern Indigenous sciences as well as those of Western sciences and will benefit from anticipatory co-governance at both domestic and international levels of the HRS.

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Look before you leap: states' prevention and anticipation duties under the right to science

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ABSTRACT

States have under the right to science an obligation to prevent or mitigate harm of scientific progress and its applications. This obligation is derived from the right to be protected against the harmful effects of scientific progress and its applications, a dimension of the right to science. However, preventing the harmful effects of scientific progress and its applications can sometimes conflict with other human rights or with scientific freedom, which is also part of the right to science. In such cases, limitations on one right might be required to protect another, whereby the different interests need to be properly balanced. While the duty to prevent harm is well established in international human rights law, it is yet obscure if the anticipation of potential harms to come is possible under the existing framework of international law. While not a legal concept, entry points for anticipation are already covered under the current international law and can be drawn together by a cross-fertilisation of the obligation to prevent, the precautionary principle and due diligence. The precautionary principle and due diligence can provide guidance on when and under what circumstances situations for anticipation are triggered and conducted. Both concepts involve a necessity and proportionality test, which is also inherent to limitations under international human rights law.

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1. Introduction

It has always been realised that 'while scientific and technological developments provide ever-increasing opportunities to better the conditions of life of peoples and nations, in a number of instances they can give rise to social problems, as well as threaten the human rights and fundamental freedoms of the individual … '[1] Examples of such developments are asbestos,[2] nuclear energy[3] or genome editing.[4] Some of these innovations and their benefits were welcomed at the outset, but in hindsight may have required some form of State intervention to prevent harm. The issues of the potential abusive use of

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science and the possible harmful effects of science and technology were present from the earliest international discussions on scientific and technological progress. They formed part of the negotiations on the inclusion of a right to science in the Universal Declaration of Human Rights (UDHR, 1948) as well as in the International Covenant on Economic, Social and Cultural Rights (ICESCR, 1966) and it was the basis of the elaboration of the UN Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind (1975) cited above.[5] The last instrument accordingly includes that States should prevent the use of scientific and technological developments that limit or interfere with the enjoyment of the human rights, and they should protect people against possible harmful effects of the misuse of science and technology.

At the time of the adoption of the ICESCR and the UN Declaration on the Use of Scientific and Technological Progress, no one could have imagined the speed with which scientific and technological developments would take place in the years to come. While scientific and technological developments have always been seemingly fast and often life-changing, the last decades have particularly shown an enormous acceleration and dynamism in science and technology, affecting everyone in everyday life. We have seen an incredible progress in, for instance, information and communication technology (internet, cell phones, computers, artificial intelligence), medical research (stem cell research, genome editing, development of vaccines and medicines), etc. Moreover, science is no longer an isolated field of work, left to scientists, researchers, and academics in laboratories and public universities. Not only are private institutions nowadays funding and hosting the bulk of research and technological advancements, but also 'ordinary people' take part in scientific and technological progress, not merely as users, but as active participants and contributors, for instance by gathering data or participating in experiments or tests.

The speed, width, and breadth of scientific and technological developments, in terms of topics and participants, have increased the benefits but also the potential risks of harmful use of science and technology – e.g. falling into the hands of the wrong people or being used for malicious purposes.[6] Moreover, they have decreased the predictability of these risks.[7] Bearing in mind the incredible complexity of the scientific enterprise, what remains of the obligations of States to prevent the use of scientific and technological developments that would limit the enjoyment of human rights, and to protect people from possible harmful effects of the misuse of science and technology? How can States reasonably or diligently anticipate the risks of harm? And what does the right to science in human rights instruments prescribe in this regard?

This paper analyses to what extent States have legal obligations under the right to science to prevent or mitigate harm resulting from the use and application of scientific progress.[8] Under harm, we understand the unjustifiable infringement on human rights. This article does not presume that all harm can be avoided. It does, however, explore whether, and if so, what obligations States have to at least try to prevent or mitigate harm and how the idea of anticipation of possible harm fits into the framework of international law.

Central starting point in this article is the right to science as laid down in the UDHR and the ICESCR.[9] We use the term 'right to science' for reasons of practicality and familiarity in dominant scholarship on this matter. However, it needs to be highlighted that the right to science should be viewed as an umbrella term for a cluster of rights.[10] The

right to science has, as explored elsewhere,[11] various dimensions, including scientific freedom, access to science and enjoyment of its benefits, but also the right to be protected against adverse effects of scientific progress and its applications. The obligation to prevent harm can arise under the right to science and it may therefore require a limitation of the right to science itself.[12] For this reason, this article examines the limitations of the right to science in human rights law by analysing how States should balance the right to be protected from the adverse effects of science with the protection and promotion of scientific freedom.

While the right to science serves as a crucial foundation for analysing the harm associated with scientific progress and its applications, this article delves beyond the right to science. It explores the broader idea of anticipation of potential harms to come and examines the obligations that States may have in preventing harm arising from scientific progress and its applications. According to the Oxford English Dictionary, anticipation is defined as 'prior action that meets beforehand, provides for, or precludes the action of another.'[13] It should be noted that anticipation is not a legal term and that it has not been referred to by UN treaty bodies. We understand anticipation therefore not as a legal concept or state obligation per se, but rather as an umbrella term that may trigger obligations due to a cross-fertilisation of tools, principles and standards from different fields of public international law. We build upon the right to science and its footing in international human rights law while making use of the precautionary principle as elaborated in environmental law and the standard of due diligence according to public international law. We explore to what extent these concepts provide further clarification or interpretation of the obligations of States to prevent harm or anticipate risks of harm deriving from scientific progress and its applications.

This article focuses on the rights and obligations of States according to international (human rights) law. There is much to discuss about the rights, obligations and responsibilities of scientists, researchers, and academics themselves. They are expected to behave ethically and responsibly throughout the process of developing, conducting, and disseminating their research and its results.[14] The fact that this is not always the case has led to a continuous debate on scientific integrity and ethics of science, including the development of self-regulatory mechanisms, such as codes of conduct. This article does not address these regulatory frameworks by and of scientists, researchers, and academics within their own community, such as non-plagiarism or disclosure of conflict of interest. Instead, this article focuses on the legal obligations of States, which may include regulations pertaining the behaviour of the said group as well. Therefore, this article mainly concentrates on the risks posed by research, which can stem from its results, but also from its original design and purpose, as well as the involvement of research subjects.

The methodology used in this article is a doctrinal analysis. We follow a black-letter approach by focusing on the *lex lata* in the relevant sources in international instruments, using the different interpretation tools as laid down in the Vienna Convention on the Law of Treaties (VCLT), including the text of the provisions and the drafting process of the right to science provisions in the UDHR and the ICESCR.[15] Additionally, we consider subsidiary means of interpretation of the right to science with a focus on the interpretations by international human rights monitoring bodies, most notably General Comment No. 25 on science and economic, social and cultural rights (hereafter

General Comment No. 25) by the Committee on Economic, Social and Cultural Rights (hereafter CESCR).[16]

Below, we first explore the recognition by States in various international instruments of the possible risks of harm that science and its applications can cause. Thereby we ask the question of what kind of obligations States did envisage for themselves to alleviate and avoid risks and harms. Next, we analyse the pertinent dimensions of the right to science that give rise to State obligations to prevent harm from scientific progress and its applications. One such obligation may be that States need to take measures limiting the right to science in order to comply with other obligations under that same right or under other human rights. Moving beyond the realm of human rights law, we subsequently explore the concepts of due diligence and the precautionary principle, along with their value as risk management tools and their role in human rights impact assessment in the broader context of human rights protection. Based on the precautionary principle and due diligence, we explore how and under what circumstances States could anticipate possible harms of scientific progress and its applications. In the last section, we highlight the most important findings and provide some final remarks on anticipation, prevention and the unpredictability of scientific and technological progress.

2. The argument for state obligations to prevent: recognition that science and technology can cause harm

2.1. UN instruments on science

States at the UN level have always been attentive to the possible harm caused by or following from scientific and technological advancements and realised that 'science can be put both at service but also to the detriment of society'.[17] This recognition in some instances led to the inclusion of obligations for States in certain instruments to try and prevent the latter from happening. States thereby accepted their duty to promote, more than to ensure, that scientific results and applications are beneficial rather than detrimental to human beings and society. It should be noted that many of these international instruments – being declarations and not treaties – are not legally binding upon States. They reflect principles or political norms to be respected by States.

The potential abusive use of science and the possible harmful effects of science were an important incentive for the adoption of the UN Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind (1975). As mentioned above, this declaration builds on the premise that scientific and technological achievements can improve the conditions of peoples and nations, but that they can also threaten their human rights and fundamental freedoms.[18] This instrument, therefore, includes in Article 2 that '[a]ll States shall take appropriate measures to prevent the use of scientific and technological developments, particularly by the State organs, to limit or interfere with the enjoyment of the human rights and fundamental freedoms of the individual … '. The central aim of this provision is to protect human rights against the harmful effects or applications of science and technology. The State is obliged to regulate and control its own activities and efforts and those it supports, in relation to scientific and technological advancements. No attention was yet paid to the duty to protect against infringements by private actors. The Declaration has a

classical horizontal character, for instance reflected in its focus on international cooperation to prevent harm. Article 1 asserts that 'all States shall promote international co-operation to ensure that the results of scientific and technological developments are used in the interests of strengthening international peace and security, freedom and independence, and also for the purpose of the economic and social development of peoples and the realization of human rights … '

After this Declaration, several instruments were adopted on specific scientific developments where States felt the need to join forces and regulate in order to prevent harm.[19] Two international instruments worth mentioning here are the Universal Declaration on the Human Genome and Human Rights, adopted by the UNESCO General Conference in 1997 and endorsed by the UN General Assembly in 1998, and the International Declaration on Human Genetic Data, adopted by the General Conference of UNESCO in October 2003. The Declaration on the Human Genome focuses on the potential abuse of science and research in relation to the human genome, but it shifts the responsibility onto researchers and scientists. It includes, for instance, that researchers have special responsibilities in carrying out their research, including meticulousness, caution, intellectual honesty and integrity.[20] It also includes that persons have the right to be informed about research on their genome and that such research should in principle not be carried out without a person's consent. If such consent is not possible, research should be conducted only for the person's health benefit or the health benefit of others.[21] Furthermore, the applications of research, including genetics and medicine, shall seek to improve the health of individuals and humankind.[22]

Furthermore, the Declaration on Human Genetic Data is based on the awareness that ' … the collection, processing, use and storage of human genetic data have potential risks for the exercise and observance of human rights and fundamental freedoms and respect for human dignity.'[23] Interestingly, it prioritises the interests and welfare of the individual over the rights and interests of society and research.[24]

2.2. UNESCO recommendation on science and scientific researchers

The UNESCO Recommendation on Science and Scientific Researchers, adopted by the General Conference of UNESCO in 2017, also recognises the benefits but also harms of science and its applications. It states that

> scientific discoveries and related technological developments and applications open up vast prospects for progress made possible in particular by the optimum utilization of science and scientific methods for the benefit of humankind and for the preservation of peace … but may, at the same time, entail certain dangers which constitute a threat, especially in cases where the results of scientific research are used against humankind's vital interests … to the detriment of human rights or fundamental freedoms or the dignity of a human person … [25]

The Recommendation, therefore, outlines that States should develop adequate policies designed to avoid possible dangers while realising and exploiting the positive prospects inherent in discoveries, technological developments and applications.[26] States should thus support scientific research that 'could improve the understanding of factors involved in the survival and well-being of humankind'.[27] The impact of science on future generations is one of the aspects to be taken into account here.[28]

According to the Recommendation, States have obligations, albeit quite soft, to promote responsible science within their own jurisdiction. For instance, States should encourage scientific researchers ' … to think of their work in terms of service both to their fellow nationals and to their fellow human beings in general.'[29] It is further included that 'Member States should encourage conditions that can deliver high-quality science in a responsible manner … .' States should also ' … establish mechanisms and take all appropriate measures aimed to ensure the fullest exercise, respect, protection and promotion of the rights and responsibilities of scientific researchers … '.[30]

Apart from trying to prevent the misuse of science, the Recommendation includes the right of researchers to step out of projects. In the list of recommended rights and responsibilities of researchers it is included that ' … in those instances where the development of science and technology undermine human welfare, dignity and human rights or is 'dual use', they have the right to withdraw from those projects if their conscience so dictates and the right and responsibility to express themselves freely on and to report these concerns'.[31] Furthermore, researchers should integrate ' … controls to minimize harm to each living subject of research and to the environment, and consultations with communities where the conduct of research may affect community members'.[32]

The recognition of the duty of States (and the responsibility of researchers and scientists) to prevent harm does however not solve the question of *how* a State can or should know whether a certain application or result is or might become risky or harmful. Many scientific and technological developments are uncertain or may have unknown (side-)effects or results. It is also not clear what States should concretely do in these cases and to what extent they have legal obligations in this regard. It seems the minimum States accepted to do was to promote that scientific and technological advancement should be directed to benefit humankind, peoples, communities and individuals. The aim of scientific progress has been discussed extensively by States, also in relation to the right to science.[33]

3. The right to science as a human right

When the right to science was discussed, halfway through the 1940s,[34] to be possibly included in the Universal Declaration of Human Rights, one of the main discussion points was the dilemma of allowing scientific freedom and promoting progress, while at the same time limiting the possible harmful effects or results of scientific and technological advancements. This comes as no surprise after the Second World War had shown the destructive nature of bombs and weapons, as well as the dangers and human rights violations related to scientific experimentation on people.

The drafting history of the UDHR, as well as that of the ICESCR, shows large awareness among the negotiators regarding the possible dangers of science and technology. The fact that the drafters chose the phrasing of 'the right to enjoy the *benefits* of scientific progress and its applications' (emphasis added) suggests that harmful or dangerous science and research were not to be protected. Another suggestion for prevention along with the protection of people from harmful and dangerous activities was to further explicate the *purpose* of science. The USSR, supported among others by the Eastern European States and China, found that such qualification of science was necessary and proposed to add that ' … the development of science must serve the interests of

progress and democracy, and the cause of international peace and co-operation.' Most delegates, however, saw this as an unwanted excuse for State interference in scientific freedom and therefore rejected it.[35]

The fact that no explicit aim was added to the final provision in the UDHR nor later in the ICESCR does not mean that States did not take the possible dangers of scientific advancement seriously. States seemingly made a distinction between the development of science itself, which should not be constrained, and the results and outcomes of science and technology, which should be directed towards human interests, such as peace, democracy, and international cooperation. As noted by Porsdam Mann: ' … the drafters were sympathetic to, if not unanimously in favour of, the idea that applications of scientific progress should be directed at peaceful and democratic ends. Yet the notion that the direction of science itself – as distinct from its applications and results – should serve any kind of ends was met with fierce critique.'[36] Indeed several subsequent instruments (also addressed above), such as the 1975 Declaration and the 2017 UNESCO Recommendation do include that the results of scientific and technological developments should be used in the interests of strengthening international peace and security.[37]

In short, the right to science does not as such include a specific aim that would direct its way and restrict freedom. Such reference was found to lead to excessive State control.[38] However, such reference was included in Article 13 ICESCR on the right to education, outlining the general purposes that education should serve. Article 13(1) states that ' … education shall be directed to the full development of the human personality and the sense of its dignity, and shall strengthen the respect for human rights and fundamental freedoms' and that ' … education shall enable all persons to participate effectively in a free society, promote understanding, tolerance and friendship among all nations and all racial, ethnic or religious groups, and further the activities of the United Nations for the maintenance of peace.' It could be argued that scientific progress should broadly serve the same aims, but this was not explicitly included in the treaty. General Comment No. 25 seems to point at this, by including that 'the development of science in the service of peace and human rights should be prioritized by States over other uses.'[39] This phrasing refers to both the development of science as well as its uses.[40]

A closer look at the black letter law and interpretation of the rights protected under the right to science reveals several interesting dimensions. States have to guarantee the right to benefit from scientific progress and its applications (REBSPA, Article 15 (1)(b) ICESCR). Yet, an *e contrario* interpretation of the same provision brings out the right to be protected against harmful activities emanating from science.[41] Therefore, the right to enjoy the benefits coexists with the right to be protected from harmful activities. Then again, these rights, in particular the latter might have implications for the right to scientific freedom. The fact that these rights coexist but also possibly stand in conflict with each other is not unusual. Rather, such a conflict of rights is inherent to human rights law. Human rights are universal, indivisible, interdependent, and interrelated. Consequently, the different rights and interests of individuals, communities, and society always have to be balanced.[42]

In short, the rights guaranteed under the right to science impose various obligations upon States to respect, protect and fulfil these rights, including obligations to prevent harm. Yet, such prevention may require limiting certain dimensions of the right to science.

3.1. Limitations of the right to science

States are allowed to limit human rights in order to protect the rights of others and/or the interests of society. The CESCR recognises in its General Comment No. 25 that 'some limitations on the right to participate in and to enjoy the benefits of scientific progress and its applications might be necessary, as science and its applications can, in certain contexts, affect economic, social and cultural rights.'[43]

If States are supposed to prevent such 'affecting' and take measures to avoid harm or infringements of human rights, does this mean that they are actually in some instances *obliged* to limit the right to science, in particular the right to benefit from scientific progress and its applications or scientific freedom?

As discussed above, the three relevant rights protected under the right to science do co-exist but may also stand in conflict with each other. This conflict of rights imposes an obligation to limit one right in order to pertain another right. Apart from not explicitly defining the aim of science, the provisions on the right to science do not contain a limitations clause.[44] This implies that the right to science is regulated by the general limitation clause as laid down in Article 4 ICESCR. According to this provision, States parties may subject the rights in the ICESCR only to such limitations that are '… determined by law only in so far as this may be compatible with the nature of these rights and solely for the purpose of promoting the general welfare in a democratic society'. The meaning of Article 4 and the criteria for limitations have been analysed extensively elsewhere,[45] which is why we only present the main findings here.

Limitations should first be determined by law, which implies that a national governance system is involved in the drafting and execution of the limitation measures. The term 'law' is interpreted broadly by the international supervisory bodies to include not only statutes but also unwritten law.[46] The CESCR has endorsed this broad understanding in several General Comments.[47] Laws must furthermore not be arbitrary, unreasonable or discriminatory and be accessible and foreseeable.[48]

Limitations may not be in contradiction with the nature of the rights in the Covenant, otherwise, the provisions would no longer have any value and substance.[49] This links to the concepts of 'core content' and 'core obligations' of human rights. According to the CESCR, limitations may not affect the minimum core of the rights since this would go against their 'nature'.[50]

Relevant to answering the question of to what extent States have an *obligation* to limit the right to science is the criterion that the limitation measures should serve a legitimate aim. The concept of 'the general welfare in a democratic society' is rather broad and vague. Research of the drafting process of Article 4 ICESCR shows that the inclusion of only 'general welfare' as a legitimate aim to limit the enjoyment of the rights was deliberate. Other possible legitimate aims, such as national security, public order, morals or respect for the rights and freedoms of others were left out of Article 4 ICESCR because they were not considered to be relevant to economic and social rights. Reasons for public morals or public order were not conceived as legitimate reasons to limit basic needs such as the right to food or health. The *travaux préparatoires* therefore seem to suggest that the words 'general welfare' should be interpreted restrictively, not including these dimensions.[51]

The UDHR as well as other human rights treaties, in particular the International Covenant on Civil and Political Rights (ICCPR), encompass more specific limitations clauses including additional legitimate aims. One of the rights closely related to the right to science and in particular scientific freedom is the right to freedom of expression and information, which may therefore serve as a good example. Article 19(3) ICCPR outlines that: 'The exercise of the rights provided for in paragraph 2 of this article carries with it special duties and responsibilities.' This sentence could also resonate with the right to science, aiming in particular at the behaviour of scientists and researchers.

Article 19(3) ICCPR continues with: 'It may therefore be subject to certain restrictions, but these shall only be such as are provided by law and are necessary: (a) For respect of the rights or reputations of others; (b) For the protection of national security or of public order (*ordre public*), or of public health or morals.' The legitimate aim of protecting national security, public order and health reflect the balance that needs to be struck between the interest of the person or group enjoying the right and the general or public interest. Respect for the rights of others as a legitimate aim reflects the balancing of different persons and groups enjoying rights. Such rights and freedoms of others do not have to be recognised in the same legal instrument.[52]

Protecting national security, public order and/or public health could be very relevant aims to limit the right to science, in particular scientific freedom or the applications of science and technology. One can think of the ethical dilemmas related to genetic research or the risks to security and public order involved in scientific and technological advancement in relation to biological and nuclear weapons. Respect for the rights and freedoms of others may also be relevant, for instance, to protect data and the privacy of persons in relation to scientific research or experiments. These aims could be accepted as justification for limitations.

This issue also came up during the drafting of the phrase included in Article 15(3) ICESCR, which includes that States should respect the 'freedom indispensable for scientific research'. While some States were critical to including the notion of 'indispensable' since this would imply that only the freedom strictly necessary for research would be protected, others argued that this notion was necessary in order to allow States to impose limitations required by national security, public order and morality.[53]

Broadening the legitimate aims for limitations could also underpin going beyond merely *justifying* limitations and trigger an *obligation* to limit human rights, in particular the right to science. It could be argued that if States know, or ought to have known,[54] of activities that may cause danger or harm to national security, public order and public health, or may cause violations of the human rights of others, they should act to prevent or mitigate these activities. The CESCR in its General Comment No. 17 already hints at such an obligation: 'States parties should prevent the use of scientific and technical progress for purposes contrary to human rights and dignity, including the rights to life, health and privacy (…).'[55] In General Comment No. 25 the CESCR adds that a '[h]uman rights impact assessments might be necessary to protect persons against risky applications.'[56]

If States take limitation measures, they are furthermore bound by the other criteria linked to limitations, namely that the measures taken are necessary and proportionate. Both are also a requirement under the precautionary principle and due diligence. The term 'necessary' implies that the limitation measures respond to a pressing social

need. This may lead to positive obligations, such as the special protection of certain groups, for instance, children, the elderly, minorities or persons with disabilities. They may be vulnerable to abuse as research subjects or are not independent decision-makers.[57] Children, for instance, may be vulnerable to misuse of information and data, such as for the purpose of human trafficking or the illicit harvest and transfer of organs.[58]

Apart from being necessary, the measures should be proportionate to the legitimate aim and the least restrictive ones needed to achieve that aim.[59] Proportionality of the measures also implies that the core content of the right cannot be limited.[60] Especially important is the weighing and balancing of interests between the rights protected under the right to science: the right to benefit from scientific progress and its applications, the right to be protected from risks of harm of scientific progress and its applications, and, last but certainly not least, scientific freedom.

The above has shown that various legitimate aims, such as the protection of national security, public order, and public health, as well as ensuring respect for and protection of the rights and freedoms of others, are very relevant to (possible) limitations of the right to science. They do not only form criteria to justify States' measures to limit the right to science,[61] but they may also trigger a positive State obligation to do so in order to protect against harmful effects or applications of scientific and technological progress, especially in relation to disadvantaged groups. One could also argue that a new legitimate aim would be appropriate in this regard, namely the protection of the environment, which could be seen as a specification of public health but is now also recognised as a human right.[62] In fact, public international law, in particular environmental law, has developed several relevant notions, including the no-harm principle, precautionary principle, and due diligence, which could further elaborate States' obligations.

4. Anticipation: the nexus between prevention, precaution and due diligence

The previous section has shown that the prevention of harm resulting from scientific progress and its applications is recognised by States in international instruments. Moreover, the right to science includes the right to be protected from adverse effects, which imposes an obligation on States to prevent such harms and may require the limitation of human rights such as scientific freedom. Moving beyond the right to science and the human rights framework, this paper will now explore other norms in international law that reflect the idea of prevention and anticipation of potential harms. Below the standard of due diligence from international law and the precautionary principle from environmental law will be analysed as entry points for anticipation, creating State obligations to prevent harm.

4.1. Due diligence

The concept of due diligence was originally developed in public international law as a State-to-State obligation to take appropriate steps to prevent harm, in particular stemming from actions by private actors.[63] The ICJ first referred to due diligence in the Corfu Channel judgement in 1949 as a 'corollary (…) duty' of sovereignty.[64] The aim

of due diligence in the context of human rights law is 'to minimise risks to human rights no matter the source of the risks, but without disproportionately limiting individual freedom or State sovereignty'.[65] Thus, the concept of due diligence should not be viewed as a free-standing obligation but rather a qualifier of behaviour that goes hand in hand with a duty of care, its underlying idea being risk management. Therefore, due diligence comes into play in situations where a risk needs to be controlled or contained to protect another actor or public interest.[66] Although due diligence is a legal concept,[67] the question of what is 'due' is not merely a matter of legal reasoning, but also a value judgement which goes beyond positive, black-letter law and requires reflections of ethics and politics.[68]

Generally, due diligence possesses elements that are uncontested in public international law. Firstly, it is not required that harm is completely prevented, but that the State acts to the best of its abilities to prevent and minimise the harm. Secondly, the measures adopted under due diligence need to be proportionate to the risk and assessed by the predictability, severity and a State's level of control. However, these are abstract formulations which provide only limited insights for the application to specific fields of law such as human rights. Moreover, the normative quality of due diligence remains unclear,[69] as well as the identification of the sources of due diligence, since it is rarely used in treaty provisions. However, the legal nature, as well as the sources of due diligence, will not be further explored in this contribution.[70]

In the context of international human rights law, due diligence describes 'the standard of conduct necessary to comply with the duty to protect.'[71] The duty to protect obliges the State to adopt measures to prevent interference of a right, no matter its source, i.e. including private actors,[72] and therefore also covers conduct that is not directly attributable to the State.[73] The Human Rights Committee in its General Comment No. 31 (2004) notes that States have positive obligations to protect individuals against violations of their rights, not only by its own agents but also by acts committed by private persons or entities. States parties violate the treaty of they do not ' … take appropriate measures or … exercise due diligence to prevent, punish, investigate or redress the harm caused by such acts by private persons or entities'.[74] Due diligence represents a standard of conduct (and not of result), originating from the standard of reasonableness and therefore requires a weighing of the affected individual and community interests. The standard of conduct must be assessed with the aid of the following three factors: a foreseeable risk; a legally protected interest; and countervailing interests, i.e. competing human rights. The assessment of these three factors is not separate, but part of a reasonableness or proportionality test.[75]

The advantage of due diligence in the context of international human rights protection is that it has the potential to address structural and systemic issues. The underlying idea of due diligence is to prevent violations of human rights, including by private actors. Therefore, it requires that States implement measures at the institutional level, e.g. the adoption of legislation and/or administrative measures; to design procedures to mitigate the possible negative impact on human rights, e.g. to establish specific training programmes; and to ensure transparency and participation by informing and educating the general public about risk management tools.[76] The subsequent steps in the due diligence implementation can be taken within the framework of a human rights impact assessment.[77]

General Comment No. 25 addresses due diligence in view of the right to science in two instances. First, the CESCR mentions due diligence in the context of risks and promises of new emerging technologies and outlines that ' … States parties should establish a legal framework that imposes on non-State actors a duty of human rights due diligence, especially in the case of big technology companies … '.[78] Second, the CESCR outlines due diligence in view of the extraterritorial obligations of States regarding the regulation and monitoring of multinational companies.[79] The topic of extraterritoriality as well as business and human rights goes beyond the scope of this contribution and will not be addressed further.

4.2. Precautionary principle

The precautionary principle – as a decision rule – may answer the question as to when and in what situations the anticipation of possible harm scientific progress and its applications arises. As mentioned earlier, anticipation is defined as 'prior action that meets beforehand, provides for, or precludes the action of another.'[80] Thus, anticipation contains an element of uncertainty, which is inherent to the precautionary principle.[81]

The precautionary principle evolved out of environmental considerations to anticipate situations where harmful activities may have detrimental and irreversible effects on human health or the environment.[82] When it became apparent that the environment could not cure itself after decades of environmental degradation, governments began to allocate the costs of environmental damage to the polluters.[83] However, this economic rule of post-damage cost-allocation had to be accompanied by a preventive mechanism for it to be effective. True to the motto 'prevention is better than the cure' and under the premise that risks can be accurately scientifically assessed, the 'preventive principle' marked the second stage of governmental action against environmental degradation. In other words, the preventive principle serves as a pre-damage mechanism when the risks are scientifically assessable and quantifiable. Yet, it quickly became clear that certain risks cannot be scientifically determined with absolute certainty. For these situations, an anticipatory model had to be developed. Therefore, in cases where a considerable amount of scientific uncertainty remains, the precautionary principle comes into play. The precautionary principle aims to 'anticipate risks suggested by possibility, contingency, and plausibility'[84] to shield humans and the environment from unpredictable consequences of human action.[85]

In the last decades, the precautionary principle has become an acknowledged strategy to cope with scientific uncertainties. Originally applied to environmental policies, the precautionary principle found its way into various international declarations, treaties, jurisprudence and State practices in diverse areas, such as sustainable development, environmental protection, public health, food safety, trade, and financial regulation.[86] Yet, no universal and uniform interpretation of the precautionary principle exists, and its legal status remains unclear.[87]

Given the increased reference to the precautionary principle in public international law, regional law including EU law, and domestic law, and its effect on scientific progress and its applications, UNESCO aimed in 2005 at establishing a working definition of the precautionary principle. Together with the World Commission on Ethics of Scientific Knowledge and Technology (COMEST), UNESCO published its working definition of

the precautionary principle so that the Member States could apply the principle for ethical assessments regarding science and technology.[88] In the years to follow, UNESCO's working definition seemed to have fallen into oblivion, as it was not mentioned in the 2017 UNESCO Recommendation on Science and Scientific Researchers.

In 2020, the CESCR picked up the thread and largely adopted UNESCO's and COMEST's definition of the precautionary principle in its General Comment No. 25.[89] It is noteworthy that the definition of the precautionary principle by the CESCR does not include the notion of morality. In the context of the right to science, the CESCR addresses the precautionary principle as follows:

> The application of the precautionary principle is sometimes controversial, particularly in relation to scientific research itself, as limitations on the freedom of scientific research are compatible with the Covenant only in the circumstances set out in article 4. On the contrary, this principle is more broadly applied for the use and application of scientific outcomes. The precautionary principle should not hinder and prevent scientific progress, which is beneficial for humanity. Nonetheless, it should be able to address available risks for human health and the environment, inter alia. Thus, in controversial cases, participation and transparency become crucial because the risks and potential of some technical advances or some scientific research should be made public in order to enable society, through informed, transparent and participatory public deliberation, to decide whether or not the risks are acceptable.[90]

The application of the precautionary principle should be necessary and proportionate. The proportionality should be according to the 'seriousness of the potential harm, with consideration of their positive and negative consequences, and with an assessment of the moral implications of both action and inaction.'[91]

Furthermore, the application of the precautionary principle is not unproblematic in practice, as '[b]y leaving behind the realm of rational certainty, precaution necessarily gives rise to controversy and its practical application to conflict.'[92] As can be seen from the statement by the CESCR on the precautionary principle,[93] the application of the principle remains unclear. Invoking the precautionary principle can have consequences for various sectors such as science, policy and governance, industry and trade as well as social and cultural implications.[94] Therefore, it is not surprising that the invocation of the precautionary principle was often accompanied by political considerations, for instance when it came to research on assisted reproduction or on human embryos.[95] Nevertheless, decisions based on the precautionary principle cannot be taken in a vacuum. This might have been the reason why the term 'morally unacceptable' harm was not included in the CESCR's definitions of the precautionary principle. Even if scientific uncertainty is the premise, decisions made under the precautionary principle do not happen in an abeyance but are, on the contrary, accompanied by decision-support tools to assess the risks in different ways (*inter alia* risk governance and cost–benefit analyses).[96] However, while these procedures are familiar amongst scientists, researchers, and academics, they might not be to the general public. Therefore, it is important to strengthen the science-policy interface, participation and transparency, as outlined in General Comment No. 25.

Moreover, it may be claimed that the precautionary principle stifles innovation, i.e. scientific freedom, in cases where the adoption of measures to anticipate risks might in hindsight prove unnecessary and thereby create false positives.[97] However, three

points can be raised to counter this claim. Firstly, the precautionary principle may also boost innovation, e.g. as a stimulant for cleaner technologies for cars to reduce carbon dioxide emissions. Secondly, in the context of international human rights law proper, it is not the precautionary principle per se that stifles innovation. State-driven regulation on innovation and therefore scientific freedom can only be allowed within the limits of human rights law and therefore the conditions set out in Article 4 ICESCR for limitations as discussed above. Putting the precautionary principle within this context, it can support decision-makers to anticipate risks, such as the detrimental effects of asbestos on health,[98] that have in retrospect turned out to be false negatives and would have needed much earlier State intervention.[99] And thirdly, it needs to be reiterated that the precautionary principle – and more so as a tool within the framework of the limitations in human rights law – is not about prohibiting all possible risks of innovations. On this note, the CESCR outlines in General Comment No. 25 that '[t]echnological and human rights impact assessments are tools that help to identify potential risks early in the process and the use of scientific applications.'[100]

Finally, the precautionary principle should be viewed as a rational decision rule, that is not based on zero risks, but on a lower, more acceptable risk. As a rational decision rule not based on anxiety or emotion, it takes into account the best use of science in order to make a wiser decision on a case-by-case basis.[101]

The above has shown that States should anticipate risks with the concepts of due diligence and the precautionary principle. What both concepts have in common is a proportionality assessment prior to the decision of which measures should be adopted. It is therefore not surprising that international courts and tribunals have suggested that both concepts are in fact interrelated and may be combined.

4.3. The interplay between prevention, precaution and due diligence

The idea of combining due diligence with the precautionary principle is not new[102] and can be traced back to the 1999 Southern Bluefin Tuna case,[103] the 2010 Pulp Mills case,[104] and the 2011 Seabed Mining Advisory Opinion.[105] In the Southern Bluefin Tuna case, the International Tribunal for the Law of the Sea (ITLOS) indirectly connected due diligence with the precautionary principle. Despite the lack of scientific certainty, the tribunal was convinced that measures should be taken to prevent further degradation of the southern bluefin tuna.[106] In the Pulp Mills case, the International Court of Justice (ICJ) indicated that due diligence stems from the preventive principle, which is now accepted as part of customary international law. Although the court did not directly address the precautionary principle, Judge Trindade in a separate opinion addressed the application of the precautionary principle in light of due diligence, since 'the epistemology of the precautionary principle is geared to the duty of care, of due diligence'.[107] Lastly, with the Seabed Mining Advisory Opinion, the ITLOS took a step further and stated that 'it is appropriate to point out that the precautionary approach is also an integral part of the general obligation of due diligence'.[108]

In short, due diligence and the precautionary principle are in fact interrelated concepts to manage risks. As outlined earlier, the preventive principle applies to situations where enough scientific evidence is available to assess risks. However, there might be cases where the risks cannot be determined with complete scientific certainty. This is the

point where the precautionary principle steps in. The precautionary principle is about anticipating, or in other words, channelling risks in advance where insufficient scientific evidence exists. To comprehend the application of the precautionary principle and the balanced consideration of diverse interests, due diligence is essential. As stated above, due diligence is a qualifier of behaviour. Because of the lack of sufficient scientific evidence, the precautionary principle boils down to the obligation of States to act diligently, since it is not possible to adopt evidence-based decisions with absolute scientific certainty. In turn, if a State '… would not meet its obligation of due diligence if it disregarded those risks … [such] disregard would amount to a failure to comply with the precautionary approach.'.[109] The concept of due diligence and the precautionary principle are thus mutually reinforcing. The precautionary principle serves as a trigger and helps to clarify and enrich the broad and unspecific concept of due diligence, both materially and procedurally, while due diligence may facilitate the application of the precautionary approach in resolving disputes.[110]

To sum it all up, States have indeed an obligation under the right to science to prevent harm and the anticipation of possible future harms may imply that the elements of prevention, precaution, and due diligence are effectively combined. The action to be taken should be necessary and proportionate to the seriousness of the risks of harm, i.e., the magnitude and reversibility of the harm as well as the likelihood for it to happen. In the context of the right to science proper, the measures taken should, however, not have disproportionate negative impacts on the benefits of scientific progress and its applications or on scientific freedom. Such a balancing of interests, i.e. the necessity and proportionality, is also inherent to the framework of limitations in international human rights law.

5. Look before you leap, but who can gaze into a crystal ball and predict the future?

In this article, we have analysed and elaborated that the protection and promotion of the right to science imply positive State obligations to prevent harm related to scientific progress and its applications, possibly including the obligation to take measures that may limit scientific freedom. Further, prevention, in combination with precaution and due diligence, reflects the idea of anticipation of possible harms to come. The mechanism to manage risks is rooted in the concept of due diligence. The precautionary principle is a risk assessment tool for situations where there is not sufficient scientific evidence and can indicate under what circumstances state action is required. What both concepts have in common is a necessity and proportionality test, which is also inherent to limitations under human rights law. In summary, limitations of human rights, the precautionary principle, and due diligence all aim at anticipating or preventing harm and are therefore deeply interrelated.

Furthermore, prevention and anticipatory measures underly a duty of conduct and most likely not of result. The main reason for this lies in the fact that it is difficult, if not impossible, to foresee all possible risks and potentially harmful results of science and its applications. The State can try to regulate via a general framework, but it cannot, and should not, unjustifiably infringe on the right to benefit from scientific progress and its applications or on scientific freedom by categorically controlling all

scientific endeavours and activities, especially not in some form of censorship. Scientific freedom and the right to benefit from scientific progress and its applications are important human rights that are crucial for any scientific progress to be made.

A closer look at the obligations of the State vis-à-vis the general welfare of society versus the role of scientists, researchers and academics, puts the application of limitations, due diligence, and the precautionary principle in perspective. While the State can be under an obligation to undertake necessary and proportionate limitations on science and technology because their results or applications are deemed not to be safe or effective, it is up to those wishing to go forward in unchartered scientific terrain to demonstrate why the adoption of the precautionary principle would be unnecessary and disproportionate. In conclusion, it can be said that the State as well as those wishing to make use of science and technology inhibit different roles in the burden of proof. States need to justify that limitations to restrict scientific freedom are necessary and proportionate to anticipate the harmful effects of science to the best of their abilities. However, those seeking to use science and technology need to demonstrate that the possible harmful effects are within the justifiable boundaries of limitations, due diligence, and the precautionary principle. In other words, the burden of proof is shared between the regulator and the proponent, which becomes relevant especially on the national level in governance and on the level of litigation.[111]

Moreover, there is the reality that States often are not in charge of the scientific and technological progress being made, which rather lies in the hands of private investors and institutions. As states may not have direct influence over the direction and the impact of this progress, this may – particularly in the case of risky or harmful activities – pose a practical challenge. This does, however, not mean that the right to science cannot be limited. Quite the contrary, States have the right, and as argued above, sometimes also the obligation, to limit scientific freedom or the right to benefit from scientific progress and its applications, whereby it has to fulfil the criteria for limitations, such as necessity, proportionality, and the preservation of the core content of the right to science. As previously stated, this goes in hand with the precautionary principle and due diligence.

The elaboration of State obligations in relation to the prevention of harm is not only challenged by the unpredictability of the whole scientific enterprise and the fact that private actors are often more powerful than the State itself. It is also hampered by the speed and complexity of science and its applications. Developments and discoveries go very fast. But more importantly, science and its applications are the fields of experts, and initiated and led by people with very specific expertise and knowledge.[112] In order to be able to appreciate all relevant aspects and dimensions of a certain research project and to predict what could be the outcome of this research and what might happen with its results, one needs to have an enormous amount of specialised knowledge and expertise. Moreover, many research projects run worldwide, involving sometimes dozens of researchers and multiple amounts of publications. The speed and complexity of science and its applications make it extremely difficult for lawmakers and policymakers to assess and anticipate their possible risks and benefits. And it makes it equally difficult for national and international monitoring bodies to evaluate States' implementation of and compliance with human rights standards, including the right to science. Finally, we recognise

that implementing measures to prevent and anticipate can in practice be challenging. Yet, utilising the framework of human rights limitations in conjunction with the precautionary principle and due diligence can be a promising pathway to support the adoption of prevention and anticipation measures.

Notes

1. UN General Assembly, 'Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind', Pub. L. No. (A/RES/30/3384), Resolution 3384 (XXX) (1975), Preamble.
2. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle' (Paris: UNESCO, March 2005), 10 f.
3. Miaomiao Yin and Keyuan Zou, 'The Implementation of the Precautionary Principle in Nuclear Safety Regulation: Challenges and Prospects', *Sustainability* 13, no. 24 (2021): 14033, https://doi.org/10.3390/su132414033.
4. Rumiana Yotova, 'Regulating Genome Editing under International Human Rights Law', *The International and Comparative Law Quarterly* 69, no. 3 (2020): 653–84, https://doi.org/10.1017/S0020589320000184.
5. See also UN Educational, Scientific and Cultural Organisation (UNESCO), 'Universal Declaration on the Human Genome and Human Rights', Pub. L. No. SHS/BIO/PI/2017/1, Universal Declaration on the Human Genome and Human Rights (1997); Yvonne Donders, 'The Right to Enjoy the Benefits of Scientific Progress: In Search of State Obligations in Relation to Health', *Medicine, Health Care and Philosophy* 14, no. 4 (1 November 2011): 371, https://doi.org/10.1007/s11019-011-9327-y.
6. The UNESCO Recommendation on the Right to Science and Scientific Researchers (2017) explains this as the development of science and technology that undermines human welfare, dignity and human rights or is 'dual use' (para. 16(a)iii). The WHO uses the term dual-use research of concern (DURC), which describes as: 'research that is intended to provide a clear benefit, but which could easily be misapplied to do harm. It usually refers to work in the life sciences, but the principles are also applicable to other fields including engineering and information technology. It encompasses everything from information to specific products that have the potential to create negative consequences for health and safety, agriculture, the environment or national security.' See https://www.who.int/news-room/questions-and-answers/item/what-is-dual-use-research-of-concern (accessed 3 January 2023).
7. United Nations Conference on Trade and Development (UNCTAD). "The Impact of Rapid Technological Change on Sustainable Development." UN, March 18, 2020. https://doi.org/10.18356/e7663910-en.
8. While this article primarily focuses on the prevention and anticipation of the risks of harm, it should be pointed out that there are also instances where the *benefits* of scientific progress and its applications can be anticipated. In fact, the anticipation of the risks of harm and benefits of scientific progress and its applications are very much part of the same coin. Hence, both sides are highly relevant in the weighing and balancing of interests in the context of proportionality and limitations. However, an in-depth analysis on the anticipation of the benefits of scientific progress and its applications would go beyond the scope of this contribution.
9. Yotova, 'Regulating Genome Editing under International Human Rights Law', 657. Some authors argue that international (human rights) law is the most appropriate legal order to regulate scientific and technological progress, since it has developed tools to balance the interests of individuals and society, as well as those of future generations.
10. See on the cluster of rights Andrea Boggio, 'The Right to Participate In and Enjoy the Benefits of Scientific Progress and Its Applications: A Conceptual Map', *New York International Law Review* 34, no. 2 (2021).

11. Samantha Besson, 'Science without Borders and the Boundaries of Human Rights : Who Owes the Human Right to Science ?', *European Journal of Human Rights* 2015, no. 4 (2015): 462–85; Boggio, 'The Right to Participate In and Enjoy the Benefits of Scientific Progress and Its Applications'; Donders, 'The Right to Enjoy the Benefits of Scientific Progress'; Yvonne Donders, 'Balancing Interests: Limitations to the Right to Enjoy the Benefits of Scientific Progress and Its Applications / Une Balance Des Intérêts – Les Restrictions Au Droit de Bénéficier Du Progrès Scientifique et de Ses Applications', *European Journal of Human Rights* 2015, no. 4 (2015): 486–503; William A Schabas, 'Looking Back: How the Founders Considered Science and Progress in Their Relation to Human Rights', *European Journal of Human Rights* 2015, no. 4 (2015): 504–18; Lea Shaver, 'The Right to Science: Ensuring That Everyone Benefits from Scientific and Technological Progress', *European Journal of Human Rights* 2015, no. 4 (2015): 411–30; Andrew Mazibrada, 'Is There a Right to Be Protected from the Adverse Effects of Scientific Progress and Its Applications?', *EJIL: Talk!* (blog), 29 November 2022, https://www.ejiltalk.org/is-there-a-right-to-be-protected-from-the-adverse-effects-of-scientific-progress-and-its-applications/ (accessed January 3, 2022); Mazibrada, Andrew, Monika Plozza, and Sebastian Porsdam Mann. "Innovating in Uncharted Terrain: On Interpretation and Normative Legitimacy in the CESCR's General Comment No. 25 on the Right to Science." The International Journal of Human Rights (Forthcoming), 2023; Monika Plozza, 'Awakening from "Sleeping Beauty's" Slumber', *Völkerrechtsblog*, 29 March 2021, https://doi.org/10.17176/20210329-194838-0; Monika Plozza, 'Evidenzbasierte Politik ist ein Menschenrecht', *Verfassungsblog: On Matters Constitutional*, 23 November 2021, https://doi.org/10.17176/20211124-064919-0; Helle Porsdam and Sebastian Porsdam Mann, eds., *The Right to Science: Then and Now* (Cambridge: Cambridge University Press, 2022), https://doi.org/10.1017/9781108776301; Sebastian Porsdam Mann, 'The Right to Science or to Wissenschaft? A Chronology and Five Lessons from the Travaux Préparatoires', SSRN Scholarly Paper (Rochester, NY, 21 November 2022), https://papers.ssrn.com/abstract=4282820 (accessed January 3, 2022); Sebastian Porsdam Mann, Helle Porsdam, and Yvonne Donders, '"Sleeping Beauty": The Right to Science as a Global Ethical Discourse', *Human Rights Quarterly* 42, no. 2 (2020): 332–56, https://doi.org/10.1353/hrq.2020.0020; Helle Porsdam, *Science as a Cultural Human Right* (University of Pennsylvania Press, 2022).
12. Mazibrada, 'Is There a Right to Be Protected from the Adverse Effects of Scientific Progress and Its Applications?'
13. *Oxford English Dictionary*, s.v. anticipation, https://www.oed.com/view/Entry/8557?redirectedFrom=anticipation& (accessed 3 January 2023).
14. Simon Godecharle et al., 'Scientists Still Behaving Badly? A Survey Within Industry and Universities', *Science and Engineering Ethics* 24, no. 6 (2018): 1697–717, https://doi.org/10.1007/s11948-017-9957-4; Brian C. Martinson, Melissa S. Anderson, and Raymond de Vries, 'Scientists Behaving Badly', *Nature* 435, no. 7043 (June 2005): 737–38, https://doi.org/10.1038/435737a.
15. United Nations (UN), 'Vienna Convention on the Law of Treaties (VCLT)', Pub. L. No. A/CONF.129/1986/WP.2, 1155 Treaty Series 311 (1969).
16. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)' (UN Committee on Economic, Social and Cultural Rights (CESCR), 30 April 2020), https://digitallibrary.un.org/record/3899847?ln=en; International Law Commission (ILC), 'Draft Conclusions on Subsequent Agreement and Subsequent Practice in Relation to the Interpretation of Treaties, with Commentaries, Adopted by ILC at Its 70th Session', Yearbook of the International Law Commission 2018, Volume II (United Nations, 2018), para. Conclusion 13(3), https://digitallibrary.un.org/record/1643630; Andrew Mazibrada, Monika Plozza, and Sebastian Porsdam Mann, 'Innovating in Uncharted Terrain: On Interpretation and Normative Legitimacy in the CESCR's General Comment No. 25 on the Right to Science', The International Journal of Human Rights (Forthcoming), 2023, 9 f. For the normative

legitimacy and practical value of the General Comment No. 25 on Science in the context of the VCLT.

17. Cristian Timmermann, 'Sharing in or Benefiting from Scientific Advancement?', *Science and Engineering Ethics* 20, no. 1 (March 2014): 117, https://doi.org/10.1007/s11948-013-9438-3.
18. UN General Assembly, Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind, Preamble.
19. It is interesting that these instruments mostly concern health issues, and for instance not communication technology or the development of weapons. The reason for this might lie in the lack of consensus among States on these issues and how to regulate them appropriately.
20. UN Educational, Scientific and Cultural Organisation (UNESCO), Universal Declaration on the Human Genome and Human Rights, Article 13.
21. *UN Educational, Scientific and Cultural Organisation (UNESCO), Article 5.*
22. *UN Educational, Scientific and Cultural Organisation (UNESCO), Article 12.*
23. UN Educational, Scientific and Cultural Organisation (UNESCO), 'International Declaration on Human Genetic Data', Pub. L. No. SHS/BIO/PI/2017/1 (2003), Preamble.
24. *UN Educational, Scientific and Cultural Organisation (UNESCO), Preamble.*
25. UN General Assembly, Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind, Preamble.
26. *UN General Assembly, Preamble.*
27. UN Educational, Scientific and Cultural Organization (UNESCO), 'Recommendation on Science and Scientific Researchers' (UN Committee on Economic, Social and Cultural Rights (CESCR), 13 November 2017), Article 19, https://unesdoc.unesco.org/ark:/48223/pf0000263618 (accessed 3 January 2023).
28. UN General Assembly Resolution A/76/L.75, adopted 26 July 2022, preamble. The rights of future generations are an important aspect of the recently adopted GA resolution on the right to a clean, healthy and sustainable environment as a human right.
29. UN Educational, Scientific and Cultural Organization (UNESCO), 'Recommendation on Science and Scientific Researchers', Article 15.
30. *UN Educational, Scientific and Cultural Organization (UNESCO), Article 16.*
31. *UN Educational, Scientific and Cultural Organization (UNESCO), Article 16(a)iii.*
32. *UN Educational, Scientific and Cultural Organization (UNESCO), Article 16(a)vii.*
33. The Recommendation on Science and Scientific Researchers makes one short reference to the right to science in Article 21: 'So as to ensure the human right to share in scientific advancement and its benefits, Member States should establish and facilitate mechanisms for collaborative open science and facilitate sharing of scientific knowledge while ensuring other rights are respected.' This does not add further substance to the right to science in human rights instruments.
34. Extensive research on this was done by Porsdam Mann, 'The Right to Science or to Wissenschaft?'
35. Porsdam Mann, 12.
36. Tara Smith, 'Scientific Purpose and Human Rights: Evaluating General Comment No 25 in Light of Major Discussions in the Travaux Préparatoires of the Universal Declaration of Human Rights and International Covenant on Economic, Social, and Cultural Rights', *Nordic Journal of Human Rights* 38, no. 3 (29 March 2021): 221–36, https://doi.org/10.1080/18918131.2021.1882757; Porsdam Mann, 'The Right to Science or to Wissenschaft?' Tara Smith, in her paper, argues that there is a tension in the 1975 Declaration, the 2017 Recommendation, and the 2020 General Comment laying out goals or purposes for science, and the explicit rejection of the same by the drafters. According to Porsdam Mann, however, this tension disappears when the distinction between science itself, on the one hand, and its results and applications on the other are kept in mind, at least for the 1975 Declaration and the 2017 Recommendation. The General Comment, however, is ambiguous on this point.

37. UN Educational, Scientific and Cultural Organization (UNESCO), 'Recommendation on Science and Scientific Researchers', Preamble; UN General Assembly, Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind, para. 1.
38. *Drafting History of Article 15 (1) (c) of the International Covenant on Economic, Social and Cultural Rights*, 2000, paras 34 and 42, https://lup.lub.lu.se/record/a6d251cc-8835-4f9b-a44c-d5d2a23b9c42; William A. Schabas, 'Study of the Right to Enjoy the Benefits of Scientific and Technological Progress and Its Applications', in *Human Rights in Education, Science and Culture: Legal Developments and Challenges*, ed. Yvonne Donders and Vladimir Volodin (Aldershot: Ashgate, 2007), 281.
39. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)' (UN Committee on Economic, Social and Cultural Rights (CESCR), 30 April 2020), para. 6, https://undocs.org/E/C.12/GC/25 (accessed 3 January 2023).
40. Rumiana Yotova and Bartha M. Knoppers, 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing', *European Journal of International Law* 31, no. 2 (21 September 2020): 673, https://doi.org/10.1093/ejil/chaa028.
41. Yotova and Knoppers, 673.
42. UN General Assembly, 'Vienna Declaration and Programme of Action', Pub. L. No. A/CONF.157/23 (1993), https://www.ohchr.org/EN/ProfessionalInterest/Pages/Vienna.aspx (accessed 3 January 2023).
43. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 21.
44. The UNESCO Recommendation includes specific State obligations in relation to the possible limitation of scientific *publications*. In Article 38 it is stated that in cases where States impose restrictions on the rights of scientific researchers to publish or communicate results, they should ensure that such restrictions are minimised and be consistent with public interest and that mechanisms for appeal are in place.
45. Donders, 'Balancing Interests'.
46. UN Human Rights Committee (HRC), 'CCPR General Comment No. 16: Article 17 (Right to Privacy), The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation', 8 April 1988, paras 3, 4 and 8; Sunday Times v. The United Kingdom, No. 6538/74 (European Court of Human Rights (ECtHR) 26 April 1979).
47. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 7: The Right to Adequate Housing (Art.11.1): Forced Evictions' (UN Committee on Economic, Social and Cultural Rights (CESCR), 20 May 1997), https://digitallibrary.un.org/record/240198?ln=en; UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 26: Land and Economic, Social and Cultural Rights' (UN Committee on Economic, Social and Cultural Rights (CESCR), 24 January 2023), https://digitallibrary.un.org/record/4002337?ln=en; UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 21: Right of Everyone to Take Part in Cultural Life (Art. 15, Para. 1 (a), of the International Covenant on Economic, Social and Cultural Rights)' (UN Committee on Economic, Social and Cultural Rights (CESCR), 21 December 2009), https://digitallibrary.un.org/record/679354?ln=en.
48. UN Commission on Human Rights, 'Limburg Principles on the Implementation of the International Covenant on Economic, Social and Cultural Rights', Items 8 and 14 of the provisional agenda, Forty-Third Session, 8 January 1987, principles no. 48-50, https://digitallibrary.un.org/record/124945?ln=en (accessed 3 January 2023); These were derived from the UN Commission on Human Rights, 'Syracuse Principles on the Limitation and Derogation of Provisions in the ICCPR', 28 September 1984, paras 15–18, https://digitallibrary.un.org/record/497167?ln=en (accessed 3 January 2023).

49. UN Commission on Human Rights, 'Limburg Principles on the Implementation of the International Covenant on Economic, Social and Cultural Rights', 122–35, principles no. 52, 56.
50. Amrei Müller, 'Limitations to and Derogations from Economic, Social and Cultural Rights', *Human Rights Law Review* 9, no. 4 (1 January 2009): 579, https://doi.org/10.1093/hrlr/ngp027; UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 21.
51. Philip Alston and Gerard Quinn, 'The Nature and Scope of States Parties' Obligations under the International Covenant on Economic, Social and Cultural Rights', *Human Rights Quarterly* 9, no. 2 (1987): 201 f.
52. UN Commission on Human Rights, 'Syracuse Principles on the Limitation and Derogation of Provisions in the ICCPR', para. 35. The Syracuse Principles were adopted by a group of international law experts and meant to elaborate and come to uniformity in the interpretation of the conditions and grounds for permissible limitations and derogations. See also Farida Shaheed, 'Report of the Special Rapporteur in the Field of Cultural Rights – The Right to Enjoy the Benefits of Scientific Progress and Its Applications', Agenda Item 3, Twentieth Session (United Nations General Assembly, Human Rights Council, 14 May 2012), 13 f., https://doi.org/10.1163/2210-7975_HRD-9970-2016149.
53. Tara Smith, 'Understanding the Nature and Scope of the Right to Science through the Travaux Préparatoires of the Universal Declaration of Human Rights and the International Covenant on Economic, Social and Cultural Rights', *The International Journal of Human Rights* 24, no. 8 (13 September 2020): 1167, https://doi.org/10.1080/13642987.2020.1715947.
54. The European Court of Human Rights has established caselaw on Article 2 (right to life) about preven-tive obligations in case of risks that States know or ought to have known: Opuz v. Turkey, No. 33401/02 (European Court of Human Rights (ECtHR) 9 June 2009); Kurt v. Austria, No. 62903/15 (European Court of Human Rights (ECtHR) 4 July 2019); Mastromatteo v. Italy, No. 37703/97 (European Court of Human Rights (ECtHR) 24 October 2002); Paul and Audrey Edwards v. the United Kingdom, No. 46477/99 (European Court of Human Rights (ECtHR) 14 March 2002).
55. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 17: The Right of Everyone to Benefit from the Protection of the Moral and Material Interests Resulting from Any Scientific, Literary or Artistic Production of Which He or She Is the Author (Article 15, Paragraph 1 (c), of the Covenant)' (UN Committee on Economic, Social and Cultural Rights (CESCR), 12 January 2006), para. 35, https://digitallibrary.un.org/record/566430?ln=en.
56. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 22.
57. UN Committee on Economic, Social and Cultural Rights (CESCR), para. 22; Shaheed, 'Report of the Special Rapporteur in the Field of Cultural Rights – The Right to Enjoy the Benefits of Scientific Progress and Its Applications', 14; AAAS Science and Human Rights Coalition, Margaret Weigers Vitullo, and Jessica Wyndham, 'Defining the Right to Enjoy the Benefits of Scientific Progress and Its Applications: American Scientists' Perspectives' (American Association for the Advancement of Science, October 2013), 10, https://doi.org/10.1126/srhrl.aaa0028; Brian Gran, Margaret Waltz, and Holly Renzhofer, 'A Child's Right to Enjoy Benefits of Scientific Progress and Its Applications', *International Journal of Children's Rights* 21, no. 2 (April 2013): 323, https://doi.org/10.1163/15718182-02102002.
58. Gran, Waltz, and Renzhofer, 'A Child's Right to Enjoy Benefits of Scientific Progress and Its Applications', 337 f.
59. UN Commission on Human Rights, 'Syracuse Principles on the Limitation and Derogation of Provisions in the ICCPR', para. 10 f.; UN Human Rights Committee (HRC), 'CCPR

General Comment No. 22: Article 18 (Freedom of Thought, Conscience or Religion)', 30 July 1993, para. 8, https://digitallibrary.un.org/record/182777?ln=en (accessed 3 January 2023); UN Human Rights Committee (HRC), 'CCPR General Comment No. 27: Article 12 (Freedom of Movement)', 2 November 1999, para. 14, https://digitallibrary.un.org/record/366604?ln=en (accessed 3 January 2023); UN Human Rights Committee (HRC), 'General Comment No. 31: The Nature of the General Legal Obligation Imposed on States Parties to the Covenant', 26 May 2004, para. 6, https://digitallibrary.un.org/record/533996?ln=en (accessed 3 January 2023).

60. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 21; Müller, 'Limitations to and Derogations from Economic, Social and Cultural Rights', 784.
61. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25', para. 22 includes that 'any limitation on the content of scientific research implies a strict burden of justifica-tion by States, in order to avoid infringing freedom of research.'
62. UN General Assembly, 'Resolution A/RES/76/300, The human right to a clean, healthy and sustainable environment', 26 July 2022, https://digitallibrary.un.org/record/3982508?ln=en (accessed 3 January 2023).
63. For an overview see Giulio Bartolini, 'The Historical Roots of the Due Diligence Standard', in *Due Diligence in the International Legal Order*, ed. Heike Krieger, Anne Peters, and Leonhard Kreuzer (Oxford University Press, 2020), 23–41, https://doi.org/10.1093/oso/9780198869900.003.0002; Samantha Besson, 'La Due Diligence En Droit International (Volume 409)', *Collected Courses of the Hague Academy of International Law*, 1 March 2019, 180 ff, http://referenceworks.brillonline.com/entries/the-hague-academy-collected-courses/*A9789004445055_02 (accessed 3 January 2023), see also Samantha Besson, *Due Diligence in International Law* (Leiden: Brill, 2023).
64. ICJ, Corfu Channel Case (United Kingdom of Great Britain and Northern Ireland v. Albania), Judgment of 9 April 1949, ICJ Reports 1949, 4, p. 22.
65. Björnstjern Baade, 'Due Diligence and the Duty to Protect Human Rights', in *Due Diligence in the International Legal Order*, ed. Heike Krieger, Anne Peters, and Leonhard Kreuzer (Oxford University Press, 2020), 107, https://doi.org/10.1093/oso/9780198869900.003.0006; see also Besson, 'La Due Diligence En Droit International (Volume 409)', para. 458 ff.
66. Besson, 'La Due Diligence En Droit International (Volume 409)', 211 f.
67. Besson, para. 252. According to Besson, due diligence is to be viewed as a matter of legal reasoning par excellence, and hence of human rights reasoning in the context of human rights.
68. Heike Krieger, Anne Peters, and Leonhard Kreuzer, eds., *Due Diligence in the International Legal Order* (Oxford: Oxford University Press, 2020), 2 f., https://doi.org/10.1093/oso/9780198869900.001.0001.
69. Besson, 'La Due Diligence En Droit International (Volume 409)', 209 ff; Krieger, Peters, and Kreuzer, *Due Diligence in the International Legal Order*, 5 ff.
70. For a more in-depth analysis see Besson, 'La Due Diligence En Droit International (Volume 409)'; Krieger, Peters, and Kreuzer, *Due Diligence in the International Legal Order*.
71. Baade, 'Due Diligence and the Duty to Protect Human Rights', 92; Besson, 'La Due Diligence En Droit International (Volume 409)', 342 ff.
72. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 24 on State Obligations under the International Covenant on Economic, Social and Cultural Rights in the Context of Business Activities' (UN, 10 August 2017), https://digitallibrary.un.org/record/1304491 (accessed 3 January 2023); United Nations (UN), 'Guiding Principles on Business and Human Rights', 2011, https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf (accessed 3 January 2023).
73. Baade, 'Due Diligence and the Duty to Protect Human Rights', 92 ff.

74. UN Human Rights Committee (HRC). "General Comment No. 31: The Nature of the General Legal Obligation Imposed on States Parties to the Covenant." Eightieth session, May 26, 2004, para 8, https://digitallibrary.un.org/record/533996?ln=en (accessed 27 May 2023).
75. Baade, 'Due Diligence and the Duty to Protect Human Rights', 97ff.
76. *Baade, 104 ff.*
77. See for example United Nations (UN), 'Guiding Principles on Business and Human Rights', 20.
78. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 75.
79. *UN Committee on Economic, Social and Cultural Rights (CESCR), para. 84.*
80. *Oxford English Dictionary*, s.v. anticipation, https://www.oed.com/view/Entry/8557?redirectedFrom=anticipation& (accessed 3 January 2023).
81. Audrey R. Chapman, 'Towards an Understanding of the Right to Enjoy the Benefits of Scientific Progress and Its Applications', *Journal of Human Rights* 8, no. 1 (31 March 2009): 22, https://doi.org/10.1080/14754830802701200.
82. Jonathan Wiener, 'Precaution and Climate Change', in *The Oxford Handbook of International Climate Change Law*, ed. Kevin R. Gray, Richard Tarasofsky, and Cinnamon P. Carlarne (Oxford University Press, 2016), https://doi.org/10.1093/law/9780199684601.003.0008.
83. Nicolas de Sadeleer, *Environmental Principles: From Political Slogans to Legal Rules*(Oxford, England: Oxford University Press, 2020), 31 ff. See for more information about the 'Polluter Pays Principle'.
84. *Sadeleer, 135.*
85. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 7.
86. A complete presentation of the history of the precautionary principle and its legal bases would exceed the scope of this article. For an overview see Wiener, 'Precaution and Climate Change'.
87. Wiener; Jeff Surtees, 'Important Concepts in Environmental Law – The "Precautionary Principle"', *Law Now* 43, no. 3 (2019): 54; Ling Chen, 'Realizing the Precautionary Principle in Due Diligence', *Dalhousie Journal of Legal Studies* 25 (2016): 1–24; Sadeleer, *Environmental Principles*; Didier Bourguignon, 'The Precautionary Principle: Definitions, Applications and Governance (in-Depth Analysis)' (LU: European Parliament, 2016), https://data.europa.eu/doi/10.2861/821468 (accessed 3 January 2023); Terje Aven, 'On the Precautionary Principle, in the Context of Different Perspectives on Risk', *Risk Management* 8, no. 3 (2006): 192–205; Yin and Zou, 'The Implementation of the Precautionary Principle in Nuclear Safety Regulation'; World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle'; Yan Huang, 'Refining the Precautionary Principle in Public International Law', *US-China Law Review* 17, no. 3 (2020), https://doi.org/10.17265/1548-6605/2020.03.001; E. Fisher, 'Is the Precautionary Principle Justiciable?', *Journal of Environmental Law* 13, no. 3 (1 March 2001): 315–34, https://doi.org/10.1093/jel/13.3.315; Caroline E. Foster, *Science and the Precautionary Principle in International Courts and Tribunals: Expert Evidence, Burden of Proof and Finality*, Cambridge Studies in International and Comparative Law (Cambridge: Cambridge University Press, 2011), https://doi.org/10.1017/CBO9780511973680; P. F. Ricci and J. Zhang, 'Benefits and Limitations of the Precautionary Principle', in *Encyclopedia of Environmental Health*, ed. J. O. Nriagu (Burlington: Elsevier, 2011), 276–85, https://doi.org/10.1016/B978-0-444-52272-6.00230-0; C. Gollier and N. Treich, 'Option Value and Precaution', in *Encyclopedia of Energy, Natural Resource, and Environmental Economics*, ed. Jason F. Shogren (Waltham: Elsevier, 2013), 332–38, https://doi.org/10.1016/B978-0-12-375067-9.00159-5; Sven Ove

Hansson, 'Risk and Safety in Technology', in *Philosophy of Technology and Engineering Sciences*, ed. Anthonie Meijers, Handbook of the Philosophy of Science (Amsterdam: North-Holland, 2009), 1069–102, https://doi.org/10.1016/B978-0-444-51667-1.50043-4; J. Hanson, 'Precautionary Principle: Current Understandings in Law and Society', in *Encyclopedia of the Anthropocene*, ed. Dominick A. Dellasala and Michael I. Goldstein (Oxford: Elsevier, 2018), 361–66, https://doi.org/10.1016/B978-0-12-809665-9.10451-3; P. F. Ricci and H. Sheng, 'Benefits and Limitations of the Precautionary Principle', in *Reference Module in Earth Systems and Environmental Sciences* (Elsevier, 2013), https://doi.org/10.1016/B978-0-12-409548-9.01935-7; O. Renn, 'Precaution and Ecological Risk', in *Reference Module in Earth Systems and Environmental Sciences* (Elsevier, 2015), https://doi.org/10.1016/B978-0-12-409548-9.09558-0; N. Veflen Olsen and Y Motarjemi, 'Food Safety Assurance Systems: Food Safety and Ethics', in *Encyclopedia of Food Safety*, ed. Yasmine Motarjemi (Waltham: Academic Press, 2014), 340–44, https://doi.org/10.1016/B978-0-12-378612-8.00437-6; Robert L. Zimdahl, 'Biotechnology', in *Agriculture's Ethical Horizon*, ed. Robert L. Zimdahl (Burlington: Academic Press, 2006), 137–77, https://doi.org/10.1016/B978-012370511-2/50010-7; D. Krewski, M. C. Turner, and M. G. Tyshenko, 'Risk Management in Environmental Health Decision', in *Encyclopedia of Environmental Health*, ed. J. O. Nriagu (Burlington: Elsevier, 2011), 868–77, https://doi.org/10.1016/B978-0-444-52272-6.00621-8. Some authors consider the Precautionary Principle to become a general principle of law according to Article 38(c) ICJ-Statute or even an emerging rule of customary international law. However, this is issue will not be addressed further as it goes beyond the scope of this publication.

88. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 14.
89. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 56 f.
90. *UN Committee on Economic, Social and Cultural Rights (CESCR), para. 57.*
91. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 14; Bourguignon, 'The Precautionary Principle'. See for the application in the EU system.
92. Sadeleer, *Environmental Principles*, 135.
93. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 56 f.
94. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 35 ff.; Anna-Maria Hubert, 'The Human Right to Science and Its Relationship to International Environmental Law', *European Journal of International Law* 31, no. 2 (21 September 2020): 625–56, https://doi.org/10.1093/ejil/chaa038; Jacqueline Peel, 'The "Rights" Way to Democratize the Science – Policy Interface in International Environmental Law? A Reply to Anna-Maria Hubert', *European Journal of International Law* 31, no. 2 (21 September 2020): 657–64, https://doi.org/10.1093/ejil/chaa042.
95. For an overview see Andrea Boggio, Cesare P. R. Romano, and Jessica Almqvist, eds., *Human Germline Genome Modification and the Right to Science: A Comparative Study of National Laws and Policies* (Cambridge: Cambridge University Press, 2020), https://doi.org/10.1017/9781108759083.

96. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 25; Bourguignon, 'The Precautionary Principle', 19.
97. Søren Holm and John Harris, 'Precautionary Principle Stifles Discovery', *Nature* 400, no. 6743 (July 1999): 398–8, https://doi.org/10.1038/22626.
98. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 10 f.
99. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 15; Bourguignon, 'The Precautionary Principle', 22; Baldoli and Radaelli, 'Evidence-Based Policy and the Precautionary Principle: Friends or Foes?'. Baldoli and Radaelli argue that it is precautionary to not put any limitations on scientific freedom, but instead establish a stronger dialogue between scientists and society by a new social contract.
100. UN Committee on Economic, Social and Cultural Rights (CESCR), 'General Comment No. 25: Science and Economic, Social and Cultural Rights (Article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', para. 56.
101. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 16.
102. For a general overview see Ling Chen, 'Realizing the Precautionary Principle in Due Diligence Realizing the Precautionary Principle in Due Diligence', *Dalhousie Journal of Legal Studies* 25, no. 1 (1 January 2016), https://digitalcommons.schulichlaw.dal.ca/djls/vol25/iss1/1 (accessed 3 January 2023).
103. International Tribunal for the Law of the Sea (ITLOS), Southern Bluefin Tuna (New Zealand v. Japan; Australia v. Japan), List of cases Nos 3 and 4 (International Tribunal for the Law of the Sea (ITLOS) 16 August 1999).
104. International Court of Justice (ICJ), Case Concerning Pulp Mills on the River Urugay (Argentina v. Uruguay) (International Court of Justice (ICJ) 2010).
105. International Tribunal for the Law of the Sea (ITLOS), Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area, Advisory Opinion (International Tribunal for the Law of the Sea (ITLOS) 1 February 2011).
106. International Tribunal for the Law of the Sea (ITLOS), Southern Bluefin Tuna (New Zealand v. Japan; Australia v. Japan), List of cases Nos 3 and 4, ITLOS Reports 1999, para. 77 ff.
107. Pulp Mills on the River Uruguay (Argentina v Uruguay), Separate Opinion of Judge Cançado Trindade (International Court of Justice (ICJ) 2010).
108. International Tribunal for the Law of the Sea (ITLOS), Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area, Advisory Opinion, ITLOS Reports 2011, para. 131.
109. *International Tribunal for the Law of the Sea (ITLOS), ITLOS Reports 2011, para. 131.*
110. Krieger, Peters, and Kreuzer, *Due Diligence in the International Legal Order*, 3.
111. World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) and UN Educational, Scientific and Cultural Organization (UNESCO), 'The Precautionary Principle', 24; Foster, *Science and the Precautionary Principle in International Courts and Tribunals*; Bourguignon, 'The Precautionary Principle', 8;13; Baldoli and Radaelli, 'Evidence-Based Policy and the Precautionary Principle: Friends or Foes?', 213; Fisher, 'Is the Precautionary Principle Justiciable?' See for an analysis on the judicial experience with the principle in Anglo-Commonwealth jurisdictions.
112. A good example is genome editing, see Rumiana Yotova, Regulating genome editing under international human rights law, ICLQ vol 69, July 2020 pp. 653-84. See also Anna-Maria Hubert, The Human Right to Science and Its Relationship to International Environmental Law, EJIL (2020), Vol. 31 No. 2, p. 631.

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Anticipation under the human right to science and under other social and cultural rights

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ABSTRACT

This article analyses how the right to science can benefit from the obligations and mechanisms related to anticipation of other, social and cultural rights. It considers how these obligations can be extended to the right to science and how they can benefit the right to science by ricochet. Hence, this article shows, on the one hand, the potential that the obligations of prevention, precaution and due diligence, when applied to, social and cultural rights, have to be extended into the context of the right to science. This analysis of obligations is followed by identifying mechanisms capable of addressing the anticipatory dimension required for implementing this right. It is therefore explored, on the other hand, how mechanisms such as indicators and HRIAs, considered useful in the framework of, social and cultural rights, can play a role in the implementation of the anticipatory aspects linked to the right to science. This analysis is based mainly on the interpretative function of quasi-judicial and jurisdictional human rights bodies.

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1. Introduction

We are in an era of extreme risks; the threat being radical, the anticipation must also be radical. The right to science appears as a response to the need to address risks and, also, as a contribution to reducing the threats to which we are exposed. This right, which has long been neglected,[1] has increasingly been developed to strengthen certain guarantees for moving forward in an uncertain world. The Covid-19 pandemic has undoubtedly contributed to rehabilitating this right, which is increasingly gaining ground in international institutions.[2] However, the content of the right to science remains largely unexplored in terms of how it can be mobilised in the face of the requirements of anticipation. Images of the future shape present decisions,[3] and it is necessary to construct an understanding of the future by examining specific aspects of the right to science in the light of other social and cultural rights.

Anticipation is not unfamiliar with the nature of human rights, on the contrary. As part of cultural rights, the right to science is consistent with economic, social, and cultural rights (ESCR). These are apprehended from the perspective of the indivisibility of human rights to the extent that they can also stem from civil and political rights in

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the jurisprudential activity of certain international monitoring bodies. In Sen's capabilities framework, ESCRs allow people to enjoy certain essential functions and capabilities.[4] A doctrinal conceptualisation has set up ESCRs as a specific category, which is somewhat vulnerable in terms of norms (they would be more like programmes, objectives, and guides for action for public authorities than individual rights) and litigation (they are weakly determined and have no precise right holders, so they cannot benefit from jurisdictional protection).[5] Therefore, some of these rights are considered objectives set for progressive implementation. Others, by contrast, are directly enforceable by courts in individual cases and imply immediate obligations for states. This justiciability at the international level has been strengthened through the adoption of the Optional Protocol to the International Covenant on Economic, Social and Cultural Rights (ICESCR) and the growing number of ESCR cases being adjudicated before regional courts and human rights bodies.[6]

However, no decision on merits of these bodies has yet been provided in relation to the right to science. In 2014, in the case *Artavia Murillo et al. v. Costa Rica*, the Inter-American Court of Human Rights (IACtHR) determined that the right to enjoy the benefits of scientific progress includes accessing medical technology necessary to exercise the right to private life and reproductive freedom.[7] The European Court of Human Rights (ECtHR) also ruled on a possible violation of the rights to private life and property due to a prohibition imposed by Italian law on the donation of embryos resulting from in vitro fertilisation and not intended for pregnancy in order to promote scientific research. The applicant complained that she could not donate her embryos conceived by medically assisted reproduction for scientific research purposes and that she was obliged to keep them in cryopreservation until their death. The Court did not find that the applicant's rights had been violated, as it considered that Italy had a wide margin of appreciation in this matter, given the lack of a European consensus and the international texts on the subject. The Court further observed that the drafting of the law in question had given rise to considerable debate and that the Italian legislator had taken account of the State's interest in protecting the embryo and that of individuals in exercising their right to self-determination.[8] Also, regarding the possibility of donating embryos for scientific research in Italy, the Committee on Economic, Social and Cultural Rights (CESCR) has recently ruled this time on a request based on the right to science provided by the ICESCR. Since the authors have not sufficiently substantiated that they may claim to be victims of a violation of their right to participate in science because of being prohibited from donating embryos to scientific research, the Committee has considered this claim inadmissible.[9]

Turning to the issue of anticipation within the institutional architecture of international human rights law, it was designed to prevent human rights violations. Indeed, the consecration of human rights in international instruments aims to ensure that these rights are guaranteed first and foremost. In this regard, they anticipate the obligations of states to prevent these rights from being violated. Non-jurisdictional mechanisms aim to monitor the implementation of human rights within states and anticipate human rights violations by ensuring that State actions comply with human rights instruments. To this end, obligations of prevention, precaution, or due diligence seek to implement the anticipatory dimension of protecting human rights. Likewise, jurisdictional mechanisms clarify the scope of these instruments and the related obligations,

promoting their effective implementation. In some cases, these bodies may have an anticipatory dimension,[10] whereas their function is essentially curative. By interpreting the obligations of states during disputes, they contribute to specifying these obligations, enabling other states to orient themselves and thus avoid infringing on rights in an anticipatory perspective. Attributing responsibility and determining reparation are also aimed at preventing further violations from being committed. The jurisprudence of these bodies is likely to trigger systematic institutional changes to prevent the violation of rights. Furthermore, these bodies can provide provisional measures when there is an imminent risk of irreparable harm and thus aim to anticipate a potential right violation or to preserve a situation until a final decision is taken.[11]

On a procedural level, there is evidence of a flexibilisation of victim status to protect potential victims from future human rights threats. In effect, human rights monitoring bodies are moving towards the need to consider the time dimension. Some decisions concern a potential violation that allows them to anticipate this future to avoid a violation that does not yet exist and may not happen. This leads to a flexibilisation of victim status,[12] admitting that the victim is only 'potential'[13] in some cases. This idea of a potential victim relating to risk for the protection of a guaranteed right opens the way to a preventive remedy.

On a substantive level, States are bound by general obligations under Article 2(1) of the ICESCR that articulates the obligation to achieve progressively the full realisation of rights by all appropriate means, including particularly the adoption of legislative measures and applying the 'maximum of available resources'.[14] This provision has a temporal qualification relevant to the anticipation study. Thus, planning and adjustment of national regulation, structures, and institutions are required for this progressive implementation. ESCR law and practice have engaged positive obligations and elaborated standards based on which compliance may be assessed. Various methods have been developed in recent years to measure whether and how individual States are progressing towards the realization of ESCR. The anticipatory dimension is thus at the heart of these rights.

Accordingly, it is necessary to analyse how obligations that consider anticipation and mechanisms relating to ESCR can be applied in the context of the human right to science. Even if this right is part of ESCR, it is worth exploring, by analogy, how such obligations could be extended to the right to science when they have an anticipatory dimension. In other words, how is the dimension of anticipation regarding the right to science potentially protected by ricochet of other social and cultural rights? What kinds of anticipation can be distinguished? What structures and processes are necessary for anticipatory action? These questions are the common thread of this demonstration. To answer them, it will first be necessary to see how general and specific obligations in the field of ESCR apply or could apply to the right to science. Then, some implementation and monitoring mechanisms will be analysed regarding the right to science.

Space precludes any attempt to be exhaustive in this paper.[15] General Comments and other materials have been selected related to ESCR to illustrate particular aspects of the anticipation that could be applicable to the right to science. Research in this area should start from the premise that these norms are open-textured and therefore call for deliberation in domestic legislatures and courts.

2. Anticipation related to the right to science under the ESCR general and specific obligations

The aim here is to address the obligations in relation to ESCR that can be extended to the right to science insofar as they include an anticipatory dimension. Thus, the obligation of progressive realisation must first be analysed as a means of organising the implementation of the right to science over time, followed by the positive obligations in relation to science, linked to prevention, precaution and due diligence, which come under the jurisdictional activity.

2.1. Progressive realization and the right to science

Although much progress has been made in clarifying the scope and content of the progressive full realisation of rights,[16] significant challenges remain for holding States accountable. These challenges are partly conceptual, as the normative contours of Article 2(1) of the ICESCR remain unclear in some ways. Nevertheless, they are also methodological, requiring more effective measures and frameworks to assess this duty comprehensively. As explained in General Comment no. 3, progressive realisation is recognition that the full realisation of all rights will generally not be achieved in a short time due to the limits of available resources.[17] In the recent case mentioned above, the CESCR had the opportunity to highlight that in vitro fertilisation, embryo and stem cell research are areas in which societal views have evolved considerably, and that science and technology are constantly evolving. Therefore, 'States should regularly update their regulations in order to harmonize them with their human rights obligations and with the evolution of society and scientific progress'.[18] This shows that the advancement of science can be seen as a lever for the advancement of the normative protection of the right to science as well as other rights.

It is, therefore, in this evolving context that States must take steps to 'progressively achieve the full realization of the rights recognized in the Covenant'. Thus, the formulation of Article 2(1) emphasises that the ultimate goal in terms of results is full realisation, while progressively characterises the process of realisation over time. These steps 'should be deliberate, concrete and targeted, using all appropriate means, including the adoption of legislative and budgetary measures'.[19] For instance, the CESCR has indicated steps to be taken within a particular time frame regarding the right to education by adopting a plan of action on primary education 'within a reasonable number of years'.[20] The ICESCR clearly states that primary education must be accessible free of charge. Secondary and higher education should be made accessible 'by all appropriate means' with the progressive introduction of free education. Hence, there is an immediately realisable and justiciable core element and a progressive plan for the realisation of the other part of the right.[21]

Thus, one of the most significant red-line concepts developed by the Committee around the doctrine of progressive realisation is concerning the 'minimum core content' of ESCR, the satisfaction of which is an obligation of immediate priority for all states regardless of levels of resources. Minimum core obligations are critically important in defining the boundaries of progressive realisation and should be understood as integral to the normative framework of Article 2(1) of the ICESCR. This notion allows

reducing the impression of arbitrariness that emerges from the term progressive realisation.[22] Setting out the essential content is also helpful from the states' perspective and anticipation needed for identifying priorities for domestic efforts to fulfil obligations, but also for international assistance and cooperation.[23]

However, the establishment of this minimum content by the CESCR can be subject to criticism. Determining the minimum content is not always easy and the obligations retained by the Committee are generally very abstract and vague.[24] Regarding the right to science, there is a consensus on the minimum obligations in certain areas, such as protecting academic freedom. However, this basis is not yet stabilised in other aspects, such as access to technology.[25] In General Comment no. 25, CESCR has established a list of such minimum obligations relating to the right to science.[26] Among these core obligations, a whole series of obligations are identified that imply an anticipatory dimension, such as the elimination of laws, policies, or practices that limit access to individuals or groups in science, scientific knowledge and its applications, or the adoption of mechanisms to avoid any risk of harm due to pseudo-science-based practices. The issue of individual participation in science is equally important, and the fact that States must ensure this through the adoption of standards and action plans or mechanisms is also anticipatory. Admittedly, these obligations are quite broad, as it is up to each State to determine the best strategy for internally promoting access to and participation in the benefits of science. While on the one hand, this latitude left to the States allows them to take into account both the resources available and the national margin of appreciation of each, on the other hand, this minimum content remains imprecise.[27]

While the minimum obligations constitute a base from which states must start for progressive realisation, the latter is read regarding the maximum available resources. This qualification refers to the resources the State mobilises internally and those it solicits and obtains from the international community.[28] The general requirement is that the State's budgetary choices take into account the priority to be given to the objective of progressive realisation, which has been reaffirmed on several occasions by the CESCR.[29]

However, when implementing the minimum core content, a State that fails to ensure the minimum level of enjoyment of the right to science can still argue that this failure is due to a lack of available resources, if it can demonstrate that every effort has been made to use all available resources to fulfil, as a matter of priority, these minimum obligations.[30] Thus, the obligation to ensure essential content remains an obligation of means and does not have the status of an obligation of result. The Committee delineates between the realisation of relevant rights as an obligation of result and the duty to take steps as an obligation of conduct.[31] What is relevant here regarding anticipation is that identifying certain essential elements shifts the burden of proof: the State must demonstrate that it cannot finance what would be necessary to provide that essential content of the right. If it cannot make this demonstration, it will be presumed to have failed in its obligation to give priority to the realisation of the right to science under its jurisdiction. Therefore, the fact that it must anticipate and plan to meet its obligation is a crucial element of anticipation to be considered.

Despite the minimum core content, the progression levels regarding the right to science remain unclear. In that case, the 'natural corollary' of the duty to make progress is a duty to not regress.[32] As the Limburg Principles state, the ICESCR is violated if a State deliberately retards or halts the progressive realisation of a right, unless it acts within a

limitation permitted by the Covenant or does so due to a lack of available resources.[33] This obligation implies that no regression in the levels of access to the benefits of science, the opportunity to participate in the scientific enterprise or to be protected from its adverse effects can be permitted. Therefore, this general obligation of progressive realisation allows for anticipation insofar as the right to science must be realised over time and for this purpose, States must take some steps. Alongside this general obligation with an anticipatory dimension, the positive obligations also require States to anticipate.

2.2. Positive obligations and the right to science

The positive obligations determined by the human rights monitoring bodies in the context of their contentious jurisdiction are intended to prevent further violations from arising.[34] In effect, the treaty body requires the State to adopt legal, administrative, or other measures to prevent similar situations from arising. Therefore, these obligations are a means for the organs to determine what the States must anticipate: on the one hand, the organs specify in the present case what the State should have done to prevent the violation and potentially hold it responsible in a corrective sense. On the other hand, they indicate what States must do in the future to prevent any violation. In this way, through the determinations of the organs, determining positive obligations serve a preventive role.

Determining positive obligations by human rights bodies enables them to specify the contours of certain anticipatory obligations, such as prevention, precaution, or due diligence. While in the context of general comments and advisory opinions, the bodies have been able to address obligations directly in the context of ESCR, in the context of litigation (except the CESCR, the African Court or the European Committee), it is by ricochet from civil and political rights that they have been addressed. Indeed, the founding texts of most monitoring bodies do not necessarily deal with ESCR, leading the bodies to develop an evolving and dynamic interpretation to take into account the social and cultural dimensions of civil and political rights. For instance, the UN Human Rights Committee, as well as the African, European, and Inter-American Courts have recognised e.g. that the right to life, previously understood primarily as a negative right, must now be understood to impose positive obligations on governments to address threats to life linked to socio-economic deprivation. It is worth discussing the trends regarding anticipation obligations that emerge from these bodies' activity.

Although no case has yet been decided on the right to science, the question of science appears more or less in the case law of certain bodies, usually linked to risk prevention and precaution, or to access to scientific information, scientific education and participation. These aspects fall short of the scope of this right as it is established by the treaty bodies' and special rapporteurs' reports and documents.[35] However, they indicate how the jurisprudence of these bodies is addressing these issues.

The principles of prevention and precaution have essentially emerged in the jurisprudence of human rights bodies in the field of health and the environment.[36] Both are closely linked to science because while in the field of prevention one is faced with a certain risk of damage, proven by science, in the case of precaution one is faced with an uncertain risk that science is not yet able to attest to the occurrence of the damage. The jurisprudence of the human rights bodies indicates certain trends when these two

principles are linked with science, which will be explored. Although, according to Bidault, the right to science contained in the right to take part in cultural life is primarily a right of access to participate in science,[37] it is accepted that the right to science has three dimensions: right to be protected from the adverse effects of science, the right to have access to the benefits of science, and the right to participate in scientific progress.[38] We will focus on what emerges from the case law of the ECtHR, and in particular on the protection against the harmful risks of science in the context of scientific experimentation and especially in its relationship with the right to health.[39]

The European Court has dealt with cases concerning protection against the harmful risks of science in the context of clinical trials. It identifies positive obligations of a substantive and procedural nature. The Court identifies procedural obligations to protect the lives of individuals in the context of scientific experimentation concerning their health. It requires States to set up an effective and independent judicial system so that the cause of death of patients in the care of the medical profession, whether in the public or the private sector, can be determined and those responsible made accountable. In some exceptional situations, where the fault attributable to the healthcare providers went beyond a mere error or medical negligence, the Court has considered that compliance with the procedural obligation must include recourse to criminal law. That obligation will be satisfied if the legal system affords victims a remedy in the civil courts, either alone or in conjunction with a remedy in the criminal courts, enabling any responsibility of the doctors concerned to be established and any appropriate civil redress to be obtained.[40]

Regarding substantive positive obligations relating to medical treatment, the Court considers that States have the duty to regulate, a duty to put in place an effective regulatory framework compelling hospitals, whether private or public, to adopt appropriate measures for protecting patients' lives. The Court has, moreover, emphasised that the States' obligation to regulate must be understood in a broader sense, including the duty to ensure the effective functioning of that regulatory framework. The regulatory duties thus encompass necessary measures to ensure implementation, including supervision and enforcement.[41] In a recent case, while the applicant's daughter was participating in a trial of a new schizophrenia therapy, she died due to an undetected heart condition that the experimental treatment had aggravated. The Court found a violation of Article 2 (right to life) of the Convention, holding that the defendant State had failed to fulfil its substantive and procedural positive obligations under the Convention.[42] The positive obligations in this case are intended to contribute to the implementation of a regulatory framework to ensure the prevention of risks.

The European Court was also challenged to strike the right balance between scientific experimentation and the protection of individuals. In one case in which the Court found the application inadmissible, the issue was a refusal by the Italian courts to allow the applicant's daughter to have access to compassionate therapy for her degenerative brain disease. This therapy was being tested and subject to restrictive access conditions under a regulatory act. The applicant alleged, inter alia, that the regulatory act had discriminated in access between those who had accessed the therapy before the act came into force. Under Articles 8 and 14 of the ECHR, the Court held that the prohibition of access to the therapy pursued the legitimate aim of health protection. It was further proportionate to that aim, and the therapeutic value of the method in question had not yet been scientifically proven.[43] Without basing this decision on the precautionary

principle, the Court based its reasoning on the scientific uncertainty of the treatment. Here, the regulatory framework was correctly set in the Court's view, and the claim was, therefore, unfounded.

Another aspect that emerges from the perspective of preventing people from suffering the adverse effects of science concerns information and consent. The Court has also emphasised that it is crucial for individuals facing risks to their health to have access to information enabling them to assess those risks. It has held, in particular, that States are bound to adopt the necessary regulatory measures to ensure that doctors consider the foreseeable impact of a planned medical procedure on their patients' physical integrity. They have also to inform patients of these consequences prior to the procedure in a manner that the latter can give informed consent.[44] In a case concerning participation in toxic gas tests, which had adverse effects to the applicant's health, the European Court found a violation of Article 8, because he did not have access to all relevant and appropriate information that would have enabled him to assess the risks involved in participating in the tests.[45] This perspective is consistent with the one adopted in the General Comment no. 25, 'participation also includes the right to information and participation in controlling the risks involved in particular scientific processes and its applications. In this context, the precautionary principle plays an important role because of the lack of certainty and the inability of transmitting informations adequately. Indeed, this precautionary principle has not yet been developed by human rights treaty bodies, but it demands that, in the absence of full scientific certainty, when an action or policy may lead to unacceptable harm to the public or the environment, actions will be taken to avoid or diminish that harm. Unacceptable harm includes harm to humans or to the environment that is: (a) threatening to human life or health; (b) serious and effectively irreversible; (c) inequitable to present or future generations; or (d) imposed without adequate consideration of the human rights of those affected'.[46]

Access to information and participation are safeguards that undeniably contribute to anticipating risks. In that case, it is appropriate to consider the place that ESCR implementation and control mechanisms should have insofar as they would contribute to anticipating risks and operationalising the principle of prevention and potentially the principles of precaution and due diligence in the context of the right to science, even if they remain unclear in the practice of the treaty bodies.

3. Anticipation related to the right to science under the ESCR implementation mechanisms

To further develop a content of anticipatory obligations under the right to science, it would be useful to explore the potential of some tools, such as human rights impact assessments and human rights indicators.

3.1. Mainstreaming the right to science into human rights impact assessments?

In General Comment no. 25, CESCR considers that 'Technological and human rights impact assessments are tools that help to identify potential risks early in the process and the use of scientific applications'.[47] Interest in human rights impact assessment (HRIA) has grown considerably over the last 15 years, even if in 1990, shortly after

the CESCR began its work, it issued General Comment no. 2 on international technical assistance measures, which recommended that UN agencies consider the Secretary-General's proposal 'that a human rights impact statement be required in connection with all major development activities'.[48]

Much of the HRIA practice has focused on examining impacts on ESCR, although it tends not to make a distinction between categories of rights. 'HRIA measures the impact of policies, programmes, projects, and interventions on human rights'.[49] It draws on more established assessment methodologies, such as environmental impact assessment[50] and social impact assessment.[51] In general, impact assessment is a process used to predict the future consequences of a proposed policy, program, or project and thereby provide the opportunity to improve it (or abandon it) before it is adopted and implemented. The International Association of Impact Assessment identifies four objectives of an impact assessment: (a) to provide information as the basis for decision-making, (b) to promote transparency and participation of affected populations in decision-making, (c) to identify procedures for mitigation or compensation for negative consequences, and (d) to contribute to sound sustainable development.[52]

A key element of measuring impact is the time perspective. An *ex ante* assessment considers the potential future impact of a policy, programme, project, or intervention on human rights. It aims to collect and analyse data with a view to predict the impact on human rights when the instrument under evaluation is implemented later. An *ex post* impact assessment examines the existing impacts that have resulted from the past implementation of a policy, programme, project, or intervention. Rather than being forward-looking, the assessment looks backwards to try to identify actual impacts on human rights. In fact, many HRIAs can be a combination of *ex ante* and *ex post* assessments.[53]

For instance, an impact assessment examining the existing impacts of the research of a pharmaceutical company in relation to a disease and therefore a group of individuals suffering from that disease allows to identify not only existing impacts (*ex post*) but also make recommendations for future directions of the research project which in turn should be assessed for their potential to affect the group (*ex ante*). The terms *ex ante* and *ex post* refer only to the timing of the assessment. However, a function of identifying the timing of the assessment will influence decisions on the choice of data collection and analysis methods and in turn, which steps should be followed to arrive at an impact statement. For example, participatory methods might be more important in *ex post* HRIAs to identify people's lived experience of a project or policy. It could allow individuals and groups to participate in the elaboration of a policy related to the scientific research to implement the right to science. For *ex ante* HRIAs, participatory methods might be relevant to identifying individual or group concerns related to the projected introduction of a policy or project or as a means of mobilising people to debate and engage with a forthcoming change.[54]

Although there is no consensus on HRIA method, there are some common features. First, HRIA is based upon an explicit human rights normative framework. Measuring the potential impacts of the proposed intervention against human rights standards, rather than against the status quo, is the key difference between HRIA and other types of impact assessment.[55] Second, the process of the impact assessment must respect and promote human rights. In particular, it should comply with five human rights principles:

information, participation, equality and non-discrimination, monitoring and accountability, and interdependence of rights.[56] Third, HRIA must contribute to the capacity of the rights-holders to claim their rights and the duty-bearers to meet their obligations.[57] This means that human rights education for both rights-holders and duty-bearers is part of the assessment process, which can contribute to the scientific education needed for participation in the framework of the right to science. Education empowers rights-holders with knowledge of their rights, which encourages participation in the assessment, as well as in future human rights causes. Education for duty-bearers is on the standards they are responsible for meeting and the processes of providing information to the public, encouraging participation, promoting equality and non-discrimination, and integrating accountability mechanisms into decision-making.

HRIAs should express likely impacts by reference to human rights norms and standards. To do so effectively, an HRIA should measure the impact of the intervention on both respect for obligations as well as fulfilment of rights. This comprises a focus on two distinct groups: the HRIA should measure the likely or real impact of the intervention on the obligations of States and others to respect, protect, and fulfil human rights. This implies for example, an examination of the capacity of States to meet their human rights obligations in light of the introduction of the intervention under examination. It also requires an assessment of the impact of the intervention on the enjoyment of rights by individuals and groups as well as their capacity to deal with any negative impact if and when it arises. For example, in the case of an assessment related to the right to science, the assessment would consider impacts of a policy or project on the availability, accessibility, acceptability, and quality of scientific goods, services, and facilities for individuals and groups.

Also, HRIA should ensure that process rights and human rights principles such as non-discrimination, participation, inclusion, and accountability, are respected. Government, corporations, or any other entity responsible for introducing the intervention should ensure adequate consultation prior to and after introduction of the intervention, act without discrimination, provide adequate information, and ensure that grievance mechanisms exist to hold all actors accountable. The other aspect of process is that the HRIA itself should respect process rights. Thus, not only should the process surrounding the introduction of the intervention be transparent, consultative, and accountable, the HRIA itself should as well.

However, it is worth to note that challenge to HRIAs relates to the potential for their appropriation and misuse by commercial or bureaucratic interests. Commercialisation refers to the potential for an HRIA industry to arise, comprising consultants, with little or no knowledge of the human rights framework, who are prepared to deliver an HRIA, principally to a corporation that is ready to pay. Bureaucratisation can also be an issue. It might occur in situations where HRIAs are institutionalised within the internal practice of governments, business enterprises, and become checklist exercises to arrive at pre-determined decisions to implement the policy or project being assessed, or if it is undertaken as a means only to validate certain policies or projects but not to question them in any serious way.[58] Reducing the human rights impact assessment to compliance with a quantifiable procedure can then be problematic.

Done correctly, HRIAs should help to collect and analyse data and information in a structured way; to empower rights-holders by making it easier to demonstrate the cause–effect relationships between policies, projects, and human rights outcomes;

build human rights capacities of organisations undertaking HRIAs; and raise awareness of human rights, the relationship between norms and standards, and the daily work of the people and organisations involved. The focus of HRIA on evaluating human rights practice can also be beneficial in questioning the appropriateness of human rights responses in a given situation and, in doing so, encouraging an internal examination that should lead to better responses and solutions in order to implement the right to science.

3.2. Measuring progressive realisation by indicators?

Alongside HRIAs that would enable the principles of anticipation and participation to be implemented in the context of the right to science, indicators[59] could be a helpful way to measure the progress of the implementation of the right to science, when considering anticipation. For example, the ECSR stated in a case that a Belgian regulatory act should have proposed a timetable for implementing the right to inclusive education. Indicators should have accompanied it to measure progress, constituting a failure to continuously and adequately monitor and evaluate the measures taken and to ensure the right to inclusive and non-discriminatory education.[60] So, to what extent and under what conditions can indicators ensure the necessary anticipation for the progressive realisation of the right to science?

ESCR indicators respond to the need to measure what is expected from States over time. To monitor its progress, a state needs to establish a normative evaluation reasoning to base the device to measure this variable dimension of the right to science.[61] Indicators fulfil two functions: first, they can help the State to monitor its progress over time, enabling the authorities to recognise when policy adjustments are required. Second, they can help to hold the state to account in relation to the discharge of its responsibilities arising from the human right.[62] They also have other roles: by highlighting issues such as participation and accountability, indicators can enhance the effectiveness of policies and programmes. In this respect, in addition to the compliance dimension they convey, indicators can be a useful tool for anticipating and thus clarifying the progressive realisation of the right to science.

The Office of the High Commissioner for Human Rights (OHCHR) and the Inter-American Commission on Human Rights, as well as non-governmental organisations such as the Centre for Economic and Social Rights, have developed structure (such as laws), process (such as resources and policy efforts), and outcome indicator frameworks to assess whether States are progressively realising ESCR.[63] This work has largely contributed to moving the issue of indicators from the political to the technical level, but also to considering them as having primarily a function of monitoring compliance with treaty provisions. According to the OHCHR Guide, monitoring is facilitated by offering a 'structured and transparent approach to applying standardized information […] to national human rights assessments'.[64] However, this is not the only use envisaged by the OHCHR Guide; it considers four other uses: performance monitoring, human rights advocacy and people empowerment, national human rights plans and development plans, and human rights budgeting.[65] From this perspective, in particular, one could ask whether the indicators would have a real impact in terms of anticipation, i.e. whether they would be able to capture the different levels of progressive realisation of the right to science.

Boggio and Gran proposed to establish indicators for the right to science following the OHCHR Guide and to define them from the trajectories of conceptualisation (what is measured), production (data collection and promulgating indicators), and use (when the indicators are used by those who did not produce the indicators).[66] They point to the need to build them according to the objectives in their proposal. In their case, they have focused on proposing indicators that monitor state compliance. Nevertheless, indicators to measure the effectiveness of programmes and plans that implement the right to science in practice could be proposed depending on the objective.[67] Their indicators are therefore based on the attributes of the right to science identified in relation to scientific freedom, access to benefits, and opportunities for participation. To monitor them, the structural indicators would relate in particular to the compliance of legislation, regulations, and policies to guarantee these three attributes. According to the authors, the processual indicators would correspond to

> implementation efforts to transform human rights commitments into the desired results. Evidence of these efforts include resource allocation, developing and deploying plans and programs, setting up institutional mechanisms, and incentives that redress violations, stimulate compliance, and promote the realization of the right.[68]

These different indicators, especially those related to processes, could help to measure the progressive implementation of the right to science. Provided that it is taken into account that human rights are non-quantifiable, and do not depend exclusively on better access to the benefits of science. It depends on how it is made available, the targets it reaches, implications, and the participation in the decision-making process by those directly concerned, and then, this mechanism would effectively serve the progressive realisation of the right to science.[69] This possibility of measurement is intimately linked to anticipation: insofar as States plan their acts for the realisation of the right, through the implementation of programmes and plans, they would anticipate what is necessary to implement in order to avoid their violation, but above all in order to realise them. The peripheral objectives of the indicators, according to the OHCHR Guide, allowing for participation, accountability, and strengthening of programmes and plans would be a primary objective in this search for the effectiveness of the indicators aiming at implementing anticipation in the framework of the progressive realisation of the right to science.

Indicators' quantitative aspect is insufficient to describe the enjoyment of a right.[70] Even if they can be effective and coherent tools, monitoring by quantification can have adverse effects.[71] Consequently, the practices surrounding the creation and use of human rights indicators also have a range of unintended negative impacts. Some of these negative effects stem from the risks inherent in quantitative modes of knowing, the problem of political manipulation of data, the abusive methods sometimes used to collect data, and the disconnect between the concept that is intended to be measured and the choice of indicators that are often remote. Other unintended consequences arise from the fact that the phenomenon of indicators is an instance of 'expert rule' that reinforces certain types of professional human rights expertise shared by a given epistemic community while excluding others. Specifically, a set of 'translator' roles is increasingly empowered because they possess technical expertise in metrics, measurement techniques, and human rights law. These translators are often hired as consultants to create, evaluate, or advise on using indicators. This empowerment sometimes comes at

the expense of local or embedded forms of knowledge. The will to quantify tends to 'technicise' debates that would otherwise be open to political contestation, removing and transforming the exercise of discretion and judgement. It also frequently manifests itself in auditing logic, where accountability becomes a relationship limited by numbers. Indicators also often use the language of management, which assumes predictability, control and thus the possibility of rational management of social and political change – a model of understanding the world that may be particularly inappropriate for human rights.[72] So, these caveats must be taken seriously into account if indicators are to be effectively used and mobilised to accompany the progressive implementation of the right to science.

This article analysed the anticipatory dimension of the right to science from the perspective of ESCR. The general obligation of progressive realisation and the positive obligations determined by human rights monitoring bodies in relation to prevention, precaution, and due diligence, which concern ESCR in general, constitute vectors for integrating anticipation in implementing the right to science. Also, the mechanisms supporting States in the implementation of ESCR, particularly the right to science, such as HRIAS on the one hand and indicators on the other, would help anticipate risks and open space for increased participation in regulatory projects and plans concerning the right to science. If the latter appear to be tools in the context of the anticipation for the right to science, they must not be used by reducing its protection to mere planning but as a complementary means towards achieving a fair implementation of this right, reinforcing its the foundations and the development.

Notes

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4. Amartya Sen, 'Elements of a Theory of Human Rights', *Philosophy and Public Affairs* 32, no. 4 (2004): 315–56.
5. E.g. David Trubek, 'Economic, Social and Cultural Rights in the Third World: Human Rights Law and Human Needs Programs', in *Human Rights in International Law: Legal and Policy Issues*, ed. Theodor Meron (Oxford: Claredon Press, 1984), 205–71, 231. The Special Rapporteur on Extreme Poverty highlighted how ESCR have been marginalised from civil and in practice, proposing a framework of recognition, institutionalisation and accountability as a response to the lack of recognition of these rights as genuine human rights. (Philip Alston, A/HRC/32/31, 28 April 2016).

6. Catarina de Albuquerque, 'Chronicle of an Announced Birth: The Coming into Life of the Optional Protocol to the International Covenant on Economic, Social and Cultural Rights - The Missing Piece of the International Bill of Human Rights', *Human Rights Quarterly* 32, no. 1 (2009): 144–78.
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8. ECtHR [GC], *Parrillo v. Italie*, no. 46470/11, (27 August 2015), para. 159.
9. CESCR, *S.C. and G.P. v. Italy*, E/C.12/65/D/22/2017, (28 March 2019), para. 6.12–6.19.
10. Ambre Blanc, *Les décisions de la Cour européenne des droits de l'homme face au temps* (Brussels: Bruylant, 2022).
11. For instance, according to article 5, paragraph 1, of the Optional Protocol, after receiving communication and before deciding on the merits, the CESCR may at any time bring to the urgent attention of the State Party concerned a request that the State Party take such provisional measures as may be necessary for exceptional circumstances to avoid possible irreparable damage to the victim or victims of the alleged violation. Article 63.2 of the American Convention on Human Rights provides the IACtHR with the explicit authority to issue precautionary measures. The European Convention of Human Rights (ECHR) does not contain explicit provisions regarding precautionary measures, but in rule 39 of its Rules of Court. See: ECtHR, *Mamatkoulov and Askarov v. Turquie*, n° 46827/99 (4 February 2005).
12. ECtHR, *Klass et al. v. Germany*, no. 5029/71, (6 September 1978), para. 36, IACtHR, *Ximenes Lopes v. Brazil*, Serie C, no. 149, (4 July 2006), para. 235.
13. For example, in *Lambert v. France*, the plaintiffs challenged a medical decision to discontinue artificial hydration and nutrition for their quadriplegic child, the ECtHR indeed recognised that if discontinued, his death would occur rapidly. Accordingly, the Court considered that he might be the victim of a potential or future violation of the right to life. ECtHR, *Lambert and others v. France*, no 46043/14, (5 June 2015), para 115.
14. Similar language can be found in other regional human rights instruments: American Convention on Human Rights, adopted 22 November 1969, Article 26. While the African Charter on Human and Peoples Rights does not expressly refer to the principle of progressive realization, the concept is widely accepted and has been implied into the Charter in accordance with Articles 61 and 62. ACHPR, 'Principles and Guidelines on the Implementation of Economic, Social and Cultural Rights in the African Charter on Human and Peoples' Rights', (2010), para. 13.
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17. CESCR, 'General Comment no. 3, The Nature of States Parties' Obligations', E/1991/23, (14 December 1990), para. 9.
18. CESCR, S.C. and G.P. (represented by counsel, Cesare Romano) v. Italy, 7 March 2019, E/C.12/65/D/22/2017, para 11.4.
19. Ibid., CESCR, 'General Comment no. 25 on article 15: Science and Economic, Social and Cultural Rights', E/C.12/GC/25, (30 April 2020), para 23; Aoife Nolan, Nicholas Lusiani, and Christian Courtis, 'Two Steps Forward, No Steps Back? Evolving Criteria on the Prohibition of Retrogression in Economic, Social and Cultural Rights', in *Economic and Social Rights after the Global Financial Crisis*, ed. Aoife Nolan (Cambridge: Cambridge University Press, 2014), 122–3.
20. CESCR, 'General Comment no. 11: Plans of Action for Primary Education', E/C12/1999/4, (10 May 1999), para. 10.
21. Article 13(2)(a), CESCR, 'General Comment no. 13: Right to Education', E/C.12/1999/10, (8 December 1999), para. 6.b. See also UNDHR Article 26(1): 'Education shall be free, at least in the elementary and fundamental stages'.

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23. The Committee stresses the national responsibility of States and the international responsibility of developed States to cooperate and assist the former in the implementation of ESCR. CESCR, 'La pauvreté et le PIDESC', E/C.12/2001/10, (2001), para 16.
24. Katharine G. Young, 'The Minimum Core of Economic and Social Rights: A Concept in Search of Content', *Yale Journal on International Law*, 33 (2008): 113–75.
25. Lea Shaver, 'The Right to Science: Ensuring that Everyone Benefits from Scientific and Technological Progress', *EJHR* 4 (2015): 411–30.
26. CESCR, General Comment no. 25, para. 52.
27. CESCR has determined in previous General Comments the minimum content of obligations relating to certain rights, such as the right to food (CESCR, GC no. 12, E/C.12/1999/5, 2000, para. 6, 14, 17), the right to education (CESCR, GC no. 13, E/C.12/1999/10, para. 57), the right to the highest attainable standard of health (CESCR, GC no. 14, E/C.12/2000/4, 2000, para. 43), the right to water (CESCR, GC No. 14, E/C./2002/11, 2002, para. 37).
28. Article 22 of the Universal Declaration of Human Rights.
29. CESCR, 'General Comment no. 19 on Social Security', E/C.12/GC/19 (2008), para. 41.
30. CESCR, General Comment no. 3, para 10.
31. Even if this distinction between obligations of conduct and of result is not emphasized again in later general comments, it is implicit in the reasonableness standard used by various monitoring bodies. Allison Corkery and Ignacio Saiz, 'Progressive Realization Using Maximum Available Resources: The Accountability Challenge', in *Research Handbook on Economic, Social and Cultural Rights as Human Rights*, Jackie Dugard et al. (Cheltenham, Northampton: Edward Elgar, 2020), 275–300.
32. Céline Romainville, *Le droit à la culture, une réalité juridique* (Brussels: Bruylant, 2014), 753–4.
33. OHCHR, 'Note Verbale from the Permanent Mission of the Netherlands to the United Nations Office at Geneva addressed to the Centre for Human Rights ("Limburg Principles")', E/CN.4/1987/17, (8 January 1987) para 72.
34. The focus here is on the positive obligations arising from case law decisions or quasi-judicial bodies. Through positive obligations, the judge sees himself as a 'creator of law'. Colombine Madelaine, *La technique des obligations positives en droit de la Convention européenne des droits de l'homme* (Paris: Dalloz, Nouvelle bibliothèque de thèses, 133, 2014), 467.
35. As for instance the obligations to respect, protect, and fulfil developed by the CESCR on its General Comment no. 25, para. 42–50.
36. The Inter-American Court has stated the substantial content of the principles of prevention, precaution and due diligence, particularly in environmental cases involving indigenous peoples, as obligations of a preventive nature. These principles emerge in the parameters the Inter-American Court chooses when it pronounces on the due performance of socio-environmental impact studies and when it sets requirements for the Free, Prior and Informed Consultation of Indigenous Peoples and Afro-descendent Communities on activities to be implemented in their territories. The general obligation of the States to prevent, established by the IACtHR, is subdivided into four duties: regulation, monitoring, conducting impact studies, and removing structural obstacles. See IACtHR, *Saramaka v. Suriname*, Serie C no. 172 (29 November 2007), para. 129; IACtHR, *Kichwa de Sarayaku v. Ecuador*, Serie C no. 245 (27 June 2012), para 186, 205–206, IACtHR, *Garífuna de Punta Piedra v. Honduras*, Serie C no. 304 (8 October 2015), para. 215; IACtHR, *Kaliña y Lokono v. Suriname*, Serie C no. 309 (25 November 2015), para 214.
37. Mylène Bidault, 'Considering the Right to Enjoy the Benefits of Scientific Progress and Its Applications as a Cultural Right. A Change in Perspective', in *The Right to Science Then and Now*, 140–9.
38. UN Special Rapporteur in the Field of Cultural Rights, Report on the Right to Enjoy the Benefits of Scientific Progress and its Applications, A/HRC/20/26 (2012).

39. Yvonne Donders, 'The Right to Enjoy the Benefits of Scientific Progress: In Search of State Obligations in Relation to Health', *Medicine, Health Care and Philosophy* 14 (2011): 371–81. This is in line with the obligation to protect identified by the CESCR on its General Comment no. 25 para 43: 'protecting people from participating in research or tests that contravene the applicable ethical standards for responsible research and guaranteeing their free, prior and informed consent'.
40. ECtHR, *Ana Ionita v. Romania*, no. 30655/09 (21 June 2016), para. 73; ECtHR [GC], *Lopes de Sousa Fernandes v. Portugal*, no. 56080/13 (15 December 2015), para. 214–215; ECtHR, *Traskunova v. Russie*, no. 21648/11 (30 August 2022), para. 81.
41. See *Lopes de Sousa Fernandes v. Portugal*, para. 186 and 189, ECtHR, *Sarishvili-Bolkvadze v. Georgia,* no. 58240/08 (19 October 2018), para. 74. See also, for the summary of the applicable principles regarding effective functioning of relevant framework in the broader context of unintentional taking of life, ECtHR, *Smiljanicc v. Croatia*, no. 35983/14 (25 March 2021), para. 66.
42. ECtHR, *Traskunova v. Russie*, para. 69–88. Here, the Court has also interpretated the European Convention on the basis of the Convention for the Protection of Human Rights and Dignity of the Human Being with Regard to the Application of Biology and Medicine of 1997, also known as the Convention on Human Rights and Biomedicine or the Oviedo Convention, para. 55.
43. ECtHR, *Durisotto v. Italie*, no. 62804/13, (28 May 2014).
44. ECtHR, *Traskunova v. Russie*, para. 70.
45. ECtHR [GC], *Roche v. The United Kingdom*, no. 32555/96 (19 October 2005), para. 162.
46. CESCR, General Comment no. 25, para 56, see also HRC, 'The right to science from the perspective of toxic products', A/HRC/48/61 (26 July 2021), para. 61–66.
47. CESCR, General Comment no. 25, para. 56.
48. CESCR, 'General Comment no. 2: International Technical Assistance Measures', E/1990/23 (1990), para. 8(b). Also, the UN Special procedures have integrated this mechanism in their work, like the Special Rapporteur on the right to education; the Special Representative on Human Rights and Businesses, the Special Rapporteur on the right to health, and the Special Rapporteur on the right to food: Katarina. Tomasevski, UN Special Rapporteur on the right to education, E/C.12/1998/18 (November 30, 1998), para. 10; John Ruggie, UN Special Representative of the Secretary-General on the Issue of Human Rights and Transnational Corporations and Other Business Enterprises, 'Human Rights Impact Assessment - Resolving Key Methodological Questions', A/HRC/4/74 (2007); Paul Hunt, UN Special Rapporteur on the Right to the Enjoyment of the Highest Attainable Standard of Health, 'Interim Report to the General Assembly', A/62/214 (2007), para. 37; Olivier De Schutter, UN Special Rapporteur on the Right to Food, 'Guiding Principles on Human Rights Impact Assessments of Trade and Investment Agreements', A/HRC/19/59/Add.5 (2011), 9–11.
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60. European Committee of Social Rights, *MDAC v. Belgium*, no. 109/2014, (29 March 2018), para. 78.
61. CESCR, General Comment no. 25, para. 88.
62. 'Report of the Special Rapporteur on the Right of Everyone to the Enjoyment of the Highest Attainable Standard of Physical and Mental Health', Paul Hunt, E/CN.4/2006/48, (3 March 2006).
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Anticipatory duties under the human right to science and international biomedical law

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ABSTRACT

This paper assesses the interplay between international human rights law and international biomedical law as two specialised regimes within international law. The focus lies specifically on the anticipatory duties arising under the human right to benefit from science and its applications on the one side and under international biomedical law on the other. International biomedical law instruments adopt a human rights-based approach to the regulation of biology and medicine, so one of the questions is whether the anticipatory duties in biomedical law are indeed a specific application of the corresponding duties in international human rights law, modified, expanded and elaborated further to better address the distinctive subject matter, namely, the interface between the individual and science and technology in a medical context? Or whether the anticipatory duties in international biomedical law draw from international environmental law and/or general international law? The main question that this paper aims to address concerns the precise scope and content of the anticipatory duties under international biomedical law and their relationship to human rights.

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1. Introduction

This paper assesses the interplay between international human rights law and international biomedical law as two specialised regimes within international law. The focus lies specifically on the anticipatory duties arising under the human right to benefit from science and its applications on the one side and under international biomedical law on the other. International biomedical law instruments claim to adopt a human rights-based approach to the regulation of biology and medicine,[1] so one of the questions that arises is whether the anticipatory duties in biomedical law are indeed a specific application of the corresponding duties in international human rights law, modified, expanded and elaborated further to better address the distinctive subject matter, namely, the interface between the individual and science and technology in a medical context? Or whether the anticipatory duties in international biomedical law draw from

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general international law or other specialised regimes within it? The main question that this paper aims to address concerns the precise scope and content of the anticipatory duties under international biomedical law and their relationship to human rights.

The paper argues that under both human rights law and international biomedical law, States have a duty to ensure respect for human dignity and human rights and related to this, an obligation to regulate on the international and domestic planes to prevent the negative effects that science and scientific research on medicine, life sciences and associated technologies can have on human dignity and human rights.[2] In this context, international biomedical law imposes specific anticipatory duties to act with due diligence in order to maximise the benefits for the affected individuals and to minimise any possible harm,[3] giving due regard to the impact of life sciences on the rights of future generations[4] through the processes of risk assessment and management.[5] Whilst not expressly incorporated in international biomedical law, the interrelated duties of prevention and precaution can be inferred from the duties to protect human rights and to minimise harm. Indeed, whilst the principles of prevention and precaution were first developed in international environmental law,[6] they are now increasingly influencing the interpretation and application of international human rights law.[7] International biomedical law borrows and adapts these anticipatory duties to ensure that medical science and technology are applied in a way respectful of human dignity and human rights, as well as to minimise the risk of harm to the individual and to humanity. Last but not least, States ought to ensure non-discriminatory, fair and equitable access to the benefits of science and its applications in order to prevent present and future inequality in the enjoyment of fundamental rights. This obligation too goes beyond human rights law and draws from general principles of non-discrimination, equity and arguably, the regime of the global commons. Recent developments pertaining to interventions in the human germline, i.e. the cells we pass to future generations, using the new CRISPR Cas-9 technology will be used as a case study to illustrate how these anticipatory duties should operate in practice in the face of a fast-developing and high-risk science and technology that promises significant benefits to the individual and humanity.

The paper begins by critically discussing the relationship between international biomedical law and international human rights law, arguing that the former incorporates human rights as an independent standard for assessing the legality of science and technology rather than translating them as individual rights in the field of biomedicine. In the second substantive part, the study discusses the nascent state of anticipatory duties in international law construing them as obligations of conduct that would benefit from more clearly defined key terms and consequences. The third and main part of the paper looks at four examples of anticipatory duties of States in relation to science and its applications, tracing their origins in international biomedical law, international human rights law, environmental law and general international law, as well as assessing their binding status under positive international law.

2. Human rights in international biomedical law

International biomedical law is as a nascent field of international law whose object of regulation are the legal issues arising out of life sciences,[8] medicine and the associated technologies as applied to human beings.[9] As such, it consists of a body of rules relevant

to life sciences that are derived from international human rights law but also international environmental law and general international law, translated into legal and ethical principles and set out in soft-law instruments.[10] International biomedical law as found in international treaties and soft law instruments will be used not only as comparison but also as an example of how human rights have informed anticipatory duties in the context of biomedicine. Indeed, it is not a coincidence that all major instruments in the field adopt or at least claim to adopt a human rights-based approach to regulating biomedicine. These include the Oviedo Convention on Human Rights and Biomedicine, the UNESCO Declarations on the Human Genome and Human Rights, on Bioethics and Human Rights and on the Responsibilities of Present Towards Future Generations. If one looks at the substance of the instruments closely, however, it becomes clear that they build on the general premise that scientific research and applications ought to be done in a manner that fully respects human dignity and human rights[11] without actually specifying how this ought to be achieved. Whilst they refer to the human rights principles of human dignity[12] and the prohibition against discrimination,[13] and mention a few substantive human rights such as the right to life,[14] the right to personal integrity,[15] the right to respect for private life[16] and the right to health,[17] these are mostly mentioned in passing without clarifying their implications for the field of biomedicine or indeed the obligation-holders.[18] Regrettably, despite its pertinence to science and technology in biology and medicine, none of the main instruments incorporate the right to benefit from science or its applications even if the Universal Declaration on the Human Genome and Human Rights does use the language of Article 15 ICESCR by requiring respect for scientific freedom, the international dissemination of scientific knowledge and the fostering of scientific co-operation.[19] Admittedly, a number of these instruments refer to the ICESCR in their preambles, which could be seen as an implicit reference to the right to benefit from science among others. The one explicit reference to the right can be found in the UNESCO Recommendation on Science and Scientific Researchers, which refers to the right to benefit from science as a basis for the recommendation that States establish and facilitate open science and the sharing of scientific knowledge.[20] The only aspect of the right to benefit from science that has so far found its way explicitly in most international biomedical law instruments is the freedom of scientific research.[21]

This overall approach suggests that international biomedical law incorporates the protection of human rights as an independent standard for assessing science and technology rather than translating concrete rights into its specific context. An example of the latter could be translating human dignity into an anticipatory standard of protection of the embryo against the possible negative effects of germline editing. The main objective is to ensure that science and technology in the field of biomedicine are developed and applied in a manner respectful of human dignity and human rights as set out in human rights instruments. Ensuring the development of science and technology in accordance with this standard can be construed as an anticipatory duty.

3. Anticipatory duties in international law

It is a truism that anticipatory duties are not well defined or developed in international law. Perhaps this is partially due to the fact that international law has traditionally developed in response to major social and political changes rather than in anticipation of them, a prime

example being the development of human rights law after the two World Wars. There are but few exceptions to this trend, such as Part XI of the UN Convention on the Law of the Sea and the Outer Space Treaty, both of which pertain to the fair and equitable access and benefit-sharing in areas beyond national jurisdiction, or the so-called global commons. Notably, both frameworks were developed before the exploitation of natural resources in these areas became practically or commercially viable. Despite the ongoing debates as to their practical effectiveness and implementation,[22] from an anticipatory law-making perspective these regimes could be seen as examples of good practice in the regulation of new science and technologies, as well as their anticipated benefits, that could be followed in other areas of common interest and high risk such as interventions in the human genome.

Another possible reason for the nascent state of anticipatory duties is the difficulty in defining clear thresholds of when they would be triggered in the case of future risk of harm or benefit and indeed, in regulating how risks should be avoided, mitigated or balanced with possible benefits. Anticipating the distribution of future unknown benefits is arguably the most difficult aspect of agreeing to undertake anticipatory duties. Last but not least, anticipatory duties are possibly less attractive to States due to the uncertainty as to what specific consequences they might entail in a future situation and how they might limit the States' regulatory space. Given their character of being obligations of conduct rather than result,[23] anticipatory duties also raise uncertainty as to their proper interpretation and application in practice. This is reinforced by the absence of clear generally accepted definitions of 'harms', 'risks' and 'benefits' across the surveyed hard and soft law instruments and in general international law.[24] However, anticipatory duties are important guarantees for not compromising substantive standards of international legal protection in the face of scientific and technological uncertainty, particularly in areas where some argue there is no applicable international law, such as in the case of interventions in the human genome, particularly germline editing.

4. Anticipatory duties in international biomedical law

In addition to human rights law, a number of anticipatory provisions of international biomedical law instruments also draw heavily from principles of general international law and international environmental law but without expressly acknowledging it. Despite this heavy 'borrowing' from other regimes of international law, biomedical law construes its own tripartite model of anticipation including the prevention of harm, the management of risks and on the maximising of benefits. This latter aspect is specific to biomedical law and is arguably motivated by the potential benefits of biomedical science and technology for the individual and for humanity.

For example, some have argued that the protections offered by human rights law automatically render germline genome editing illegal under international law.[25] This is not in line with the Lotus principle stating that restrictions upon State sovereignty cannot be presumed.[26] Furthermore, it is preferable to see human rights law and international biomedical law as a guarantee that when viable, germline editing can be undertaken with due regard to human dignity, the right to life, the right to health and the right to benefit from science so as to promote these rights and to maximise the benefits of the technology for the individual and humankind. The anticipatory duties imposed by the right to benefit from science are particularly pertinent in this context.

4.1. Duty to regulate to prevent the negative effects of science and to promote its benefits

It has long been established that States have an obligation to bring their domestic laws in accordance with their international obligations once they have undertaken them.[27] The anticipatory duty to regulate to prevent the negative effects of science on human dignity and the enjoyment of human rights, as well as to promote its benefits can be seen as a corollary to the general obligations of *pacta sunt servanda* and relatedly, of bringing domestic law in accordance with international law but extended to cover future situations.

The duty to regulate to prevent the negative effects of science and to promote its benefits is not expressly formulated as such in the international instruments setting out the right to benefit from science. Nor is the link of this duty to the enjoyment of human rights. However, these can be extrapolated through interpretation. If we take as a starting point Article 15 of the International Covenant on Economic, Social and Cultural Rights (ICESCR), States recognise the right of everyone to enjoy the *benefits* of scientific progress and its applications. *Per argumentum a contrario*, the choice of the words 'benefits' and 'scientific progress' implies that in order to fulfil the right, States ought to protect everyone from the negative effects of science and technology. This interpretation is supported by the 2012 Report of the Special Rapporteur in the Field of Cultural Rights[28] and by the Committee on Economic, Social and Cultural Rights (CESCR) in its General Comment No. 17 on Article 15(1)(c) ICESCR,[29] as well as by the contributions of States during the discussions of the ESC.[30] The Guidelines on Treaty-Specific Documents expressly link the duty of prevention to the protection of human dignity and human rights by requiring States to provide specific information on the 'measures taken to prevent the use of scientific and technical progress for purposes which are contrary to the enjoyment of human dignity and human rights.'[31] Similarly, General Comment No 17 provides that 'States parties should prevent the use of scientific and technical progress for purposes contrary to human rights and dignity, including the rights to life, health and privacy'.[32] The Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and Its Applications goes even further in imposing an anticipatory duty on States to regulate the activities of third parties to prevent them from using science and technology in a manner inconsistent with human dignity and human rights,[33] including specifically the taking of 'legislative measures, to prevent and preclude the utilization by third parties of science and technologies to the detriment of human rights and fundamental freedoms and the dignity of the human person by third parties'.[34]

Despite the earlier position of the CESCR and of General Comment No 17, surprisingly, General Comment 25 on the Right to Enjoy the Benefits of Scientific Progress (General Comment 25) does not mention the duty to regulate to prevent from the negative effects of science. Instead, it focuses on the narrower obligation of States to protect from the specific harmful consequences of pseudo-science.[35] General Comment 25 does, however, support the anticipatory duty of States to promote the benefits of science in providing that States ought to adopt 'policies and measures that expand the benefits of these new technologies while at the same time reducing their risks'.[36] Interestingly, it indirectly supports the duty to regulate science and new technologies on the *international* plane by emphasising that international cooperation should be enhanced with a view to

developing global regulations so as to manage effectively some of the more serious risks on new technologies, highlighting the governance gap left by fragmented national responses to transnational technologies.[37] General Comment 25 also recommends that States promote multilateral agreements to prevent the risks related to the development of science and technology or to mitigate their effects.[38] Notably, international regulation is encouraged rather than mandated and there is no mention of similar regulation being required domestically.

The obligation to regulate to prevent the negative effects of science and its applications finds further elaboration and specification in the field of international biomedical law. The Oviedo Convention on Human Rights and Biomedicine, which is the only binding international instrument in the field, requires States to take the necessary measures in their domestic laws to give it effect[39] and clarifies that the misuse of biology and medicine can lead to acts endangering human dignity.[40] These could be seen as an emanation of the obligation on States to regulate genetic interventions in order to ensure their safety and compliance with human rights. Similarly, the UNESCO Universal Declaration on the Human Genome and Human Rights together with its preparatory works suggest that there is an emerging positive obligation on States to regulate high risk genetic interventions, such as genome editing, in order to ensure they are in accordance with human dignity, human rights and notably, the rights of future generations.[41] In particular, Article 11 of the Universal Declaration on the Human Genome mandates that practices contrary to human dignity shall not be permitted, inviting States and international organisations to co-operate in identifying such practices and taking the measures necessary at both the national and international levels to ensure the respect for the principles set out in the Declaration. Interestingly the provision contains no reference to practices contrary to human rights. In addition, Article 15 makes an anticipatory recommendation that the freedom of research on the human genome should be subject to the standards of respect for human rights, fundamental freedoms and human dignity, as well as to the protection of public health.

With respect to the duty to regulate to maximise benefits, Article 12(a) of the Universal Declaration on the Human Genome requires that the applications of research on the human genome, including those in biology, genetics and medicine, pursue specific objectives in 'seek[ing] to offer relief from suffering and improve the health of individuals and humankind as a whole'. In the context of maximising future benefits from scientific research, Article 17 recommends that States foster research whose objective is the identification, prevention and treatment of genetically based and genetically influenced diseases, including rare and also endemic diseases which affect large numbers of people. This is another manifestation of the promotion of the benefits of science. The only instrument providing limited guidance on how to balance the prevention of the negative effects of science with the maximisation of its possible benefits is the Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind. It calls on States to 'take measures to extend the benefits of science and technology to all strata of the population and to protect them, both socially and materially, from possible harmful effects of the misuse of scientific and technological developments'.[42] Here, the maximisation of the benefits is understood as ensuring equitable access to them.

Overall, the duty to regulate to prevent the negative effects of science and its applications and to promote their benefits is still emerging in both international human rights law and in international biomedical law. However, it could be seen as a corollary to the well-established obligation of States to ensure respect for human dignity and human rights within their jurisdiction and as such not needing express legal incorporation. The crux of the obligation in international biomedical law is informed by human rights law in that science and technology ought not have negative effects on human dignity and human rights. It is not clear, however, how precisely this ought to be achieved in practice. From a normative standpoint and in the interest of legal certainty, it would be desirable to see this obligation become more explicit and better fleshed out given the fast developments in science and technologies with the potential to significantly promote human rights whilst also carrying the risk of impairing them. The balance between preventing negative effects and maximising benefits needs further elaboration too. Regulation through legally binding instruments at both the domestic but especially on the international level is particularly desirable in the field of interventions in the human genome where there have been significant advances but also undesirable developments, such as the editing of twins in China to make them resistant to HIV in the face of significant scientific uncertainty as to the safety of the experiment or its benefits for the children who did not carry the virus.[43]

4.2. Duties to act with due diligence in preventing harm and maximising benefits

The obligation to act with due diligence in preventing harm is now well established in international environmental law, as is the corollary procedural obligation to conduct an impact assessment in the face of a risk of significant harm.[44] The anticipatory duty to act with due diligence in preventing harm is starting to influence human rights law too.[45] The procedural obligations relating to risk assessment and management that stem from the duty to act with due diligence in preventing harm are commonly incorporated in instruments dealing with human rights in the context of biomedical law. They can be seen as an influence primarily from environmental law but with a human rights dimension given that the anticipation and management of risk is directed at the individual, their human dignity and human rights.

General Comment 25 frames the obligation of due diligence in the prevention of harm under the umbrella of the precautionary principle, despite its controversial character, interpreted as entailing an obligation to act to avoid or minimise the risk of future morally unacceptable harm in the face of scientific uncertainty. Notably, the precautionary principle is invoked in the context of the right to information and participation of the public in controlling the risks involved in scientific progress and its applications rather than as a stand-alone standard for the behaviour of States when making decisions about science and technology more broadly. The General Comment defines 'morally unacceptable harm' as including 'harm to humans or the environment that is (a) threatening to human life or health, (b) serious and effectively irreversible, or (c) inequitable to present or future generations'.[46] Regrettably, there is no mention of harm to human dignity or human rights. This is the only instance in which the General Comment mentions the rights of future generations. It goes on to identify technological and human

rights impact assessments as tools for identifying risks relating to the process and use of scientific applications.[47] The main consequence of the engagement of the precautionary principle seems to be providing for public participation and transparency in controversial cases of scientific research, rather than requiring States to take all necessary measures to avoid the risk of or to prevent harm as they ought to do under international environmental law.

General Comment 25 also encourages States parties to prevent and mitigate health-related risks to the individual by ensuring that medicines and medical treatments are evidence-based, that risks are evaluated and communicated clearly and transparently to patients to help inform their consent.[48] It recommends that States Parties to the ICESCR should establish legal frameworks imposing human rights due diligence obligations on non-State actors, particularly business entities so as to identify, prevent and mitigate risks of violations.[49]

It would have been preferable for the General Comment to rely on the well-established principles of due diligence and the obligation to prevent harm rather than solely on the precautionary approach when grounding the anticipatory duties related to science and new technologies. The duties of preventing harm and mitigating risks should have been formulated in mandatory language given their grounding in other regimes of international law dealing with risky activities, rather than as mere recommendations. It is also regrettable that the General Comment does not include the positive anticipatory duty to maximise the benefits of science and its applications, which is emphasised in the international biomedical law instruments in the area. Moreover, it is the balance between preventing harm and maximising benefits with respect to science and its new technological applications that is the most important and difficult to strike in practice. Whilst it is helpful that the Comment defines 'harm', it is very regrettable that it focuses solely on physical harm and does not include harm to human dignity or human rights, despite mentioning human rights impact assessment as a tool for preventing harm. It would have been desirable to have a definition of 'risk' and 'benefits' too, as well as an indication as to the threshold at which the anticipatory duties are triggered.

The international instruments in the field of biomedical law do not expressly mention the precautionary approach or the duty of due diligence in preventing harm. They focus instead on the corollary procedural anticipatory duties of carrying out an impact assessment of both risks and benefits, of weighing the possible risks and benefits for both the individual and for humanity as a whole, as well as of taking due account of the rights of future generations to inform decision-making. For example, the Universal Declaration on the Human Genome requires rigorous assessment of the potential risks but also of the benefits pertaining to the individual's genome prior to any research, treatment or diagnosis that involves it.[50] The UNESCO Declaration on Bioethics and Human Rights emphasises not only the need of risk assessment but also of adequate risk management in relation to medicine, life sciences and associated technologies.[51] Related to this, it recommends that States give due regard to the impact of life sciences on future generations.[52]

With respect to the balancing between risks and benefits, the UNESCO Declaration on Bioethics and Human Rights recommends that in applying and advancing scientific knowledge and technologies, the benefit to affected individuals such as patients should be maximised and any possible harm ought to be minimised.[53] The Oviedo Convention

on Human Rights and Biomedicine adopts a proportionality approach in requiring that scientific research on a person may only be undertaken if, *inter alia*, 'the risks which may be incurred by that person are not disproportionate to the potential benefits of the research'.[54] In general, all instruments provide that in case of conflict, the interests and welfare of the individual will always prevail over the interests of science and society.[55] Most of the instruments, however, fail to offer more detailed guidance on how to strike the balance between minimising the risk of harm with the possible benefits in the face of scientific uncertainty. Most balancing models seem to focus primarily on the risks and benefits of science and technology for a patient or a directly affected individual rather than the broader risks and benefits for the community or indeed humanity as a whole.

There are some instruments which account for the broader public interest in the context of maximising benefits. For example, the UNESCO Declaration on Bioethics and Human Rights stresses that the applications of research in genetics and medicine concerning the human genome 'shall seek to offer relief from suffering and improve the health of individuals and humankind as a whole.'[56] The requirement in the Oviedo Convention on Human Rights and Biomedicine that genetic interventions ought to be undertaken only for preventive, diagnostic or therapeutic purposes and provided that their aim is not to introduce any germline modification, can be read in similar vein.[57] During the drafting of the Convention in the late 90s, following an intensive debate as to the safety of germline editing it was decided that the procedure was too risky at the time and therefore it was outlawed.[58] However, the ban was intended to be only temporary and subject to periodic review in light of the most recent scientific and technological developments.[59] Interestingly, during the drafting of the Oviedo Convention, the working party discussed as an alternative approach to banning germline modifications allowing them in exceptional cases, provided that: (i) that there was no conceivable alternative that would correct recognised abnormalities, (ii) that the purpose was to alleviate severe human suffering and (iii) that strict standards of reliability and safety were met.[60] This is the most detailed guidance on what the minimising of risk and maximising of benefit analysis should look like in the context of germline editing and could be used as a starting point for discussion in the negotiation of a future binding instrument in the field. This model can be seen as a translation of the proportionality analysis to the germline editing context as it specifies what the risks and benefits are in the context of germline editing, namely the risks posed by a genetic abnormality that cannot be corrected otherwise on the one side and the alleviation of human suffering for the individual concerned and more broadly for humanity. It also defines the applicable standard of due diligence as a strict standards of reliability and safety.

4.3. Duty to give due regard to the rights of future generations

The obligation to give due regard to the impact of life sciences on the rights of future generations is another anticipatory duty found in biomedical law instruments that can be seen as a manifestation of the principles of precaution, prevention and due diligence extended in time to include consideration of the near and distant future.[61] It can be construed as a standard of good decision-making in the face of a risk of harm that may materialise in the future calling on States to take due account of the rights of future

generations when allowing activities which may affect them. The rationale of the standard is to help ensure that the existence, rights and well-being of the future generations won't be compromised or significantly undermined by the actions of the present ones. This concept too originated in environmental law and is commonly found in environmental treaties,[62] as well as in some treaties relating to the protection of cultural heritage.[63] It is also rooted in the concept of sustainability of human rights as defined in the Sustainable Development Goals.[64] There are only a few treaties involving individual rights that use the concept of future generations.[65] More recently, the rights of future generations started being used in instruments regulating biomedicine.[66]

The 'rights' of future generations are not 'rights' properly so-called, as there is no right holder, the object of protection does not yet exist, nor is there a human right-based substantive content. The obligation holder are arguably the present generations who are too abstract and general a subject to impose duties on under international law or to legally hold to account. It is better to think of the rights of future generations as an abstract legal concept expressing a general principle of intergenerational equity and imposing procedural obligations on States to act with precaution and due diligence with respect to activities likely to affect future generations so as to prevent harm to them.

The 'rights of future generations' are the most anticipatory of all anticipatory duties in international law. They can be construed as imperfect duties to anticipate that are not owed to anyone in particular or that are owed to everyone, i.e. society, the international community or humanity as a whole. They are particularly relevant to the regulation of science and new technologies related to health, especially those aimed at modifying the human germline, as these will have an inevitable, significant but uncertain impact on future generations. Accordingly, States should regulate high-risk scientific and technological applications that will impact upon the rights of future generations. In particular, they should take into account the risk of harm, as well as the benefits for the existence, well-being and rights of future generations when making decisions concerning both the legality and permitted applications of interventions in the human genome, as well as act with due diligence to prevent possible harm. This could be achieved through continuous impact assessments of the possible long-term consequences, risk-monitoring, risk-management and constant re-evaluation when authorising specific scientific and technological applications. Arguably, another important consequence of the anticipatory duty to take due account of the rights of future generations is to provide the public access to scientific knowledge and to allow public participation in the decision-making concerning high risk and benefit science and technology. Such an approach is adopted in the Aarhus Convention,[67] which regulates environmental matters.[68] No one is better placed to represent and take responsibility on behalf of the present generations than the global public who should be enabled to contribute to the debates concerning the levels of acceptable risk and harm, as well as the desirable benefits when it comes to biomedicine. Informed, pluralistic and democratic public debate on the fundamental questions raised by the developments in biomedicine and their possible applications are mandated by the Ovideo Convention and a number of the soft law instruments in the field.[69]

According to the UN Declaration on the Responsibilities of the Present Generations Towards Future Generations, in the field of the human genetics the concept entails a basic obligation to ensure that scientific and technological progress do not impair or compromise the preservation of the human species.[70] UNESCO declarations in the

field provide for a mix of obligations and recommendations to give due regard to the impact of life sciences on the rights of future generations so as not only to safeguard but also to promote their rights.[71] For instance, the Preamble of the Oviedo Convention emphasises the beneficence aspects of the obligation in requiring 'that progress in biology and medicine should be used for the benefit of present and future generations'.[72] The Universal Declaration on Bioethics and Human Rights defines as one of its objectives the dual obligation to safeguard and promote the rights of present and future generations.[73] It recommends that States give due regard to the impact of life sciences on future generations and their genetic constitution.[74] The UN Declaration on the Rights of Future Generations requires that '[t]he present generations have the responsibility of ensuring that the needs and interests of present and future generations are fully safeguarded.'[75] As a minimum, the present generations *should* strive to ensure the continuation of humankind with due respect for the dignity of the human person.[76]

The UNESCO Declaration on Science and the Use of Scientific Knowledge focuses on the positive obligation to promote the rights of future generations. It requires sciences to be of service to humanity as a whole and contribute, *inter alia*, to better quality of life for present and future generations.[77] It also provides that scientific research and the use of knowledge from that research should always aim at the welfare of humankind and take fully into account the responsibility towards present and future generations.[78] The UNESCO Recommendation on Science and Scientific Researchers requires States to ensure that scientific research and development are carried out for the protection and enhancement 'of the cultural and material well-being of [their] citizens in the present and future generations'.[79]

Regrettably, the Universal Declaration on the Human Genome and Human Rights does not contain a reference to the rights of future generations, however, the concept was discussed during its drafting. There was some confusion as to its character during the discussions of the International Bioethics Committee, which considered the concept of 'future generations' as forming part of the concept of 'humanity' and, as such, a subject of international law that had rights and responsibilities towards itself,[80] including the obligations to protect its genetic diversity.[81]

It is not a coincidence that even international biomedical law instruments, which commonly employ the concept of the rights of future generations, do not actually link it to the protection of human rights. Most define it as entailing an obligation not to compromise the existence of the future generations, many also refer to ensuring a benefit for them and some link it to protecting their interests and well-being. It is only the UN Declaration on the Rights of Future Generations that links the concept to human dignity but steps short of referring to human rights. The possible tension between construing future generations as right-holders and the rights of children has been rightly highlighted by scholars.[82] Indeed, there are also those who define the rights of future generations as referring to 'the [human] rights of current youth and children when they grow into adulthood, as well as other people who will live in the future.'[83] These scholars try to justify the idea of future generations as human right-holders on the basis of the universality of human rights, which transcends time, as well as with reference to the principle of human dignity.[84] However, the question as to the temporal scope of human rights protection is far from uniformly settled, particularly in the context of the start of life and personhood.[85] As confirmed by the ECtHR, under the ECHR, 'the full protection of the right

to life starts only with the birth of the child'.[86] Whilst it might be normatively appealing to use the concept of the rights of future generations to bridge the gap in human rights protection between those who are born and those who are yet to be born, including those who are already conceived, such an extension of the concept is not currently grounded in positive international law. It is not present in human rights treaties and indeed, the UN High Commissioner on Human Rights herself referred to 'the principle of intergenerational equity recognized in the Paris Agreement' that 'places a duty on us to act as responsible stewards of our environment, and ensure that future generations can fulfil their human rights.'[87] Arguably, the concept of the rights of future generations can be extended to encompass the obligation not to compromise the dignity of future generations and their ability to enjoy basic human rights, including the right to life and the right to health.

4.4. Duty to give access to the benefits of science and its applications

The duty to give access to the benefits of science and its applications is arguably the most controversial anticipatory duty in both human rights and biomedical law but also one of the most important ones, given the emphasis on equality of access with respect to economic, social and cultural rights.[88] The rationale behind it is to prevent future inequality in access to science and technology, which may, among other things, lead to inequality in the enjoyment of fundamental human rights. For example, to avoid a 'brave new world' where only those with significant resources have access to germline editing to ensure healthier, stronger or smarter descendants. The controversy is partly due to the tension between the right to benefit from science and its applications on the one side and the right of authors to benefit from the moral and material interests resulting from their scientific production.[89] Another practical challenge is that most of modern day scientific progress and especially its applications are driven by private actors rather than States, so it is important to incentivise such initiatives though IP law protections which in turn could make it more difficult for States to afford giving access to the benefits of science and its applications to everyone without discrimination. Last but not least, giving access to scientific applications to everyone could involve significant costs for States. For example, the most recent development in somatic genome editing therapy to treat the genetic blood diseases sickle cell anemia and beta thalassemia costs around $2.8 mln per person, making it 'the most expensive single dose drug'.[90] There is also uncertainty as to the type of access States ought to give to the benefits of science and its applications – is it merely non-discriminatory access or the more intensive forms of equitable, affordable or even free access? Ultimately, it falls upon States to legislate in order to make sure that human rights continue to apply to individuals and corporations working in the field of biomedicine.

The Guidelines on Treaty-Specific Documents to be Submitted by States Parties under Articles 16 and 17 of the ICESCR support an interpretation of Article 15 that requires States Parties 'to ensure affordable access to the benefits of scientific progress and its applications for everyone, including disadvantaged and marginalized individuals and groups'.[91] According to the ESC, accessibility as a key aspect of the content of the right entails free access to scientific information and affordable access to scientific applications. Similarly, the Special Rapporteur in the Field of Cultural Rights held that 'States

should ensure that the benefits of science are physically available and economically affordable on a non-discrimination basis.'[92]

General Comment 25 on the other hand speaks merely of 'equal access to the applications of science, particularly when they are instrumental for the enjoyment of other economic, social and cultural rights.'[93] It is not clear what 'equal' means and whether it is the same as the better-established category of 'non-discriminatory' access. When clarifying the obligation to fulfil the right to benefit from science, the Comment makes a qualified more ambitious recommendation that '[s]cientific progress and its applications should be, as far as possible, accessible and affordable to persons in need of specific goods or services.'[94] With respect to access to science, the Comment speaks of 'open science' whilst acknowledging that it cannot be achieved by States alone and requires the contribution of all stakeholders, particularly those whose research was financed by public funds.[95] The General Comment also recognises that IP law can negatively affect access to the benefits of science and requires States 'to take all steps to avoid the possible negative effects of IP on the enjoyment of the right',[96] including making all efforts through their domestic regulations and international agreements on IP to avoid an 'unacceptable prioritization of profit for some over the benefit for all.'[97] The Comment requires that a balance is reached between IP protection on the one side and open access and sharing of scientific knowledge and the access to the benefits of science, specifically those linked to the realisation of the right to health, on the other.[98] However, no further guidance is given as to concrete steps that can be taken to achieve this in practice. The only specification given is that States party have a duty to prevent unreasonably high costs for access to, *inter alia*, essential medicines.[99]

Notably, the Comment uses hortatory language when speaking about States promoting scientific research through financial support and other incentives to create new medical applications and make them accessible and affordable to everyone, including the most vulnerable.[100] General Comment 25 also uses the aspirational language of 'should' in recommending that the benefits of any scientific research and its applications are shared with the international community and particularly, developing countries.[101]

In effect, General Comment 25 adopts the interpretation that States have an obligation to give equal access to the benefits of science and its applications whilst recommending that they should go further and strive to provide affordable access. This approach can be contrasted with the more progressive attitude adopted in General Comment 14 on the Right to the Highest Attainable Standard of Health which emphasises that accessibility is one of the essential elements of the right,[102] defining it as both physical and economic, i.e. affordability.[103] General Comment 14 underlines that 'States have a special obligation to provide those who do not have sufficient means with the necessary … health care facilities'.[104] General Comment 14 interprets the anticipatory duty to give access as one of giving equitable access to scientific applications and new technologies relevant to human health. From a normative standpoint, this is the better interpretation, however, the approach adopted in General Comment 25 better reflects what happens in practice. The obligation of giving equitable access to health facilities could have important financial implications for States who introduce genome editing at the clinical level as they would have to make it affordable to the socially disadvantaged groups irrespective of whether it is a publicly or privately provided service.

The key concerns of giving access to new technologies relevant to health and of preventing them from replicating if not exacerbating social inequalities are addressed somewhat inconsistently in international biomedical law too. The UNESCO Declaration on Human Rights and Biomedicine defines as one of its aims 'to promote equitable access to medical, scientific and technological developments as well as the greatest possible flow and the rapid sharing of knowledge concerning those developments and the sharing of benefits, with particular attention to the needs of developing countries'.[105] The Declaration also uses hortatory language in suggesting that the benefits resulting from scientific research and its applications should be shared not only domestically but also with the international community as a whole with special emphasis on the needs of developing States.[106]

The Universal Declaration on the Human Genome and Human Rights is more progressive in mandating that the benefits from the advances in biology, genetics and medicine concerning the human genome 'shall be made available to all, with due regard for the dignity and human rights of each individual'.[107] It does not clarify, however, whether this entails equal, equitable or free access.

The Oviedo Convention is more explicit in this respect, with Article 3 requiring parties to provide equitable access to health care. The drafters considered this to be an important application of the principle of non-discrimination, meaning that, 'Parties could not refuse a disabled person equitable access to health care even if such care costs more than average.'[108] However, the provision was not intended to create an individual right enforceable against the State but merely to affirm an economic and social objective subject to the available resources and the needs of the individual concerned.[109] Article 3 of the Oviedo Convention could be seen as an example of good practice, addressing the broader equality challenges posed by new healthcare technologies while leaving regulatory space for States to determine whether access would be open, free or equitable. It is to be hoped that this approach would be followed in any new instrument regulating genetic interventions.

5. Conclusion

The anticipatory duties of States in relation to scientific progress and its applications are increasingly important given the fast development of science and technology, particularly in the context of human health. Without these anticipatory duties it will be very difficult to prevent the possible negative effects of science and technologies on the individual and humanity or to maximise their benefits. Yet, most anticipatory duties are relatively new and underdeveloped.

The obligation to regulate high risk science and technology in the field of biomedicine can be seen as a foundation for all anticipatory duties of the State in this field. It is grounded in general international law and a good faith interpretation of the human right to benefit from science and its applications.

The duties to act with precaution and due diligence in preventing harm stem from international environmental law but refocused on the dignity and rights of the individual as the object of protection. They have important implications for the management of risks to the individual and their human dignity and human rights in the face of scientific uncertainty. Whilst merely duties of conduct rather than result, they can contribute

significantly to improving the decision-making process of States by requiring impact assessments, public participation in decision-making and the taking of due account of the rights of future generations. Notably, international biomedical law adapts the traditional risk v benefit analysis from environmental law into a model seeking to minimise harm whilst maximising benefits.

The obligation to give access to the benefits of science is the least settled anticipatory duty of States. Whilst it is clear that such access ought to be given on a non-discriminatory basis, it is far from certain whether States are required to give equal, equitable, open or free access. There is increasing support for a duty to provide equitable access to science and technology coming from human rights law bodies and converging into biomedical law instruments.[110] Whilst normatively desirable, this process has not yet fully materialised as a matter of positive international law.

It can be hoped that in fulfilling their duty to regulate high risk science and technology, States will in the future conclude a binding universal international biomedical law instrument based on human rights and overseen by an international institution to clarify and further elaborate these anticipatory duties.

Notes

1. See e.g, UNESCO Universal Declaration on Bioethics and Human Rights (2005), art. 2 and 3; UNESCO Universal Declaration on the Human Genome and Human Rights (1997), art 2 and Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Human Rights and Biomedicine (1997) ('Oviedo Convention on Human Rights and Biomedicine'), Art 1.
2. CESCR, General Comment No. 17 The Right of Everyone to Benefit from the Protection of the Moral and Material Interests Resulting from any Scientific, Literary or Artistic Production of Which He or She is the Author (2005), E/C.12/GC/1712, at para. 35 and General Comment No. 25 on science and economic, social and cultural rights (2020), E/C.12/GC/25, at para. 81.
3. UNESCO Universal Declaration on Bioethics and Human Rights, *supra* note 2, art. 4 Benefit and Harm.
4. Ibid, art. 16 Protecting Future Generations. See also UN Declaration on the Responsibilities of the Present Generations Towards Future Generations (1997), art. 6 Human Genome and Biodiversity and UNESCO Declaration on Science and the Use of Scientific Knowledge (1999), at para. 39.
5. Ibid, art. 20 Risk Assessment and Management.
6. See e.g., Pierre-Marie Dupuy and Jorge Viñuales, *International Environmental Law* (Cambridge: Cambridge University Press, 2015), at 55-71. See in general Caroline Foster, *Science and the Precautionary Principle in International Courts and Tribunals* (Cambridge: Cambridge University Press, 2011).
7. See e.g., 'The Precautionary Principle' UNESCO (2005); *Tătar v Romania,* ECtHR, Judgment 27 January 2009, (Application No 67021/01), at paras 106-107; and M Malaihollo, 'Due Diligence in International Environmental Law and International Human Rights Law: A Comparative Legal Study of the Nationally Determined Contributions under the Paris Agreement and Positive Obligations under the European Convention on Human Rights', *Netherlands International Law Review* 68, (2021):121.
8. Biological sciences including biology, biochemistry, anatomy and genetics according to the online edition of the Oxford English Dictionary, https://www.oed.com/dictionary/life-science_n?tab=factsheet#9939460052 (last accessed August 24, 2023).
9. UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, article 1 Scope.

10. See in general Roberto Andorno, *Principles of International Biolaw: Seeking common ground at the intersection of bioethics and human rights* (Bruxelles: Bruylant, 2013) and Chamu Kuppuswamy, *The International Legal Governance of the Human Genome* (London and New York: Routledge Taylor & Francis Group, 2009).
11. See e.g. Universal Declaration on the Human Genome and Human Rights, Preamble, *supra* note 2, at para. 6, UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 3.
12. UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 3(a); Universal Declaration on the Human Genome and Human Rights, *supra* note 2, art 1 and 2(a).
13. Universal Declaration on the Human Genome and Human Rights, *supra* note 2, art 6 and UNESCO Declaration on Bioethics and Human Rights, art 11.
14. UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 2(c).
15. Ibid, art 8.
16. Oviedo Convention on Human Rights and Biomedicine, *supra* note 2, art 10.
17. Ibid, art 14(2).
18. But see ibid, art 2.
19. Universal Declaration on the Human Genome and Human Rights, *supra* note 2, art 12 and 18.
20. UNESCO Recommendation on Science and Scientific Researchers (2017), s. 21.
21. Ibid, Art 12 and 14 and UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 2(d).
22. See e.g, Isabel Feichtner and Surabhi Ranganathan, 'International Law and Economic Exploitation in the Global Commons: Introduction', *European Journal of International Law* 30, no. 2 (2019): 541.
23. See *Certain Activities Carried out by Nicaragua in the Border Area* (Costa Rica v Nicaragua) and *Construction of a Road in Costa Rica along the San Juan River* (Nicaragua v Costa Rica), ICJ Reports 2015 noted by Rumiana Yotova, 'The Principles of Due Diligence and Prevention in International Environmental Law', *Cambridge Law Journal* 75, no. 3 (2016):445.
24. Admittedly, there are persuasive definitions offered in interpretative documents, such as in General Comment No 25, *supra* note 3, which defines 'benefit'. However, these are not legally binding or generally accepted.
25. Katherine Drabiak, 'The Nuffield Council's green light for genome editing human embryos defies fundamental human rights law', *Bioethics* 34 (2020): 223. But see Andrea Boggio and Rumiana Yotova, 'Gene Editing of Human Embryos is not Contrary to Human Rights Law: A Reply to Drabiak', *Bioethics* 35, no. 9 (2021): 956.
26. *The Case of SS Lotus (France v Turkey),* PCIJ Reports, Ser. A, No. 10 (1927), at 18.
27. *Exchange of Greek and Turkish Populations*, Advisory Opinion, PCIJ Reports, Ser B No 10 (1925), at 29.
28. Report of the UN Special Rapporteur in the Field of Cultural Rights, Farida Shaheed 'The Right to Enjoy the Benefits of Scientific Progress and Its Applications' UNCHR (2012) UN Doc A/HRC/20/26, at para. 43
29. Ibid and General Comment No. 17, at para. 35.
30. General Discussion on the Right to Take Part in Cultural Life as Recognized in Article 15 of the ICESCR, ESC (1992), E/C.12/1992/2, at paras 207 and 220.
31. Guidelines on Treaty-Specific Documents to be Submitted by States Parties under Articles 16 and 17 of the ICESCR, ESC (2008), E/C.12/2008/2, at para. 70(b).
32. General Comment No 17, at para. 35.
33. Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and Its Applications (2009) ('Venice Statement'), at para. 14(a).
34. Ibid, at para. 15(a).
35. General Comment No 25, at para. 52 (11).
36. Ibid, at para. 74.
37. Ibid.
38. Ibid, at para. 81.

39. Oviedo Convention on Human Rights and Biomedicine, art 1(2).
40. Ibid, Preamble, at para. 11.
41. UNESCO, *Birth of the Universal Declaration on the Human Genome and Human Rights* (UNESCO, 1999), International Consultation, at 71.
42. Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind, GA Res, 3384 (XXX) (1975), at para. 6.
43. 'World's first gene-edited babies created in China', *The Guardian*, 26 November 2018: https://www.theguardian.com/science/2018/nov/26/worlds-first-gene-edited-babies-created-in-china-claims-scientist (accessed August 24, 2023).
44. See in general Anne Peters, Heike Kieger and Leonard Kreuzer, 'Due Diligence: the risky risk management tool in international law', *Cambridge International Law Journal* 9, no. 2 (2020):121 and Yotova, 'The Principles of Due Diligence and Prevention in International Environmental Law', at 445. See in particular, Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), art 4(2); Epsoo Convention on Environmental Impact Assessment in a Transboundary Context (1991); Convention on the Law of the Non-Navigational Uses of International Watercourses (1997), art 7(1) and 2; and Paris Agreement (2015), art 7(9)(c). See also *Responsibilities and Obligations of States with Respect to Activities in the Area,* Advisory Opinion, ITLOS Reports 2011, at para. 145; *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v Nicaragua)* and *Construction of a Road in Costa Rica along the San Juan River (Costa Rica v Nicaragua)*, at paras 104, 153 and 168.
45. See e.g., Convention on Preventing and Combating Violence against Women and Domestic Violence (2011), Art 5.
46. General Comment No. 25, *supra* note 3, at para. 56.
47. Ibid.
48. Ibid, at para. 71.
49. Ibid, at para. 75.
50. Universal Declaration on the Human Genome, *supra* note 2, art 5.
51. UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art. 20 Risk Assessment and Management.
52. Ibid, art. 16 Protecting Future Generations.
53. Ibid, art. 4 Benefit and Harm.
54. Oviedo Convention on Human Rights and Biomedicine, *supra* note 2, art 16(ii).
55. Ibid, Art 2. See also UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 3(2).
56. Oviedo Convention on Human Rights and Biomedicine, *supra* note 2, article 12(b).
57. Ibid, art 13.
58. Steering Committee on Bioethics, CDBI/INF, *Preparatory Works on the Convention on the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine*, (Strasbourg, Council of Europe, 2000), at 64.
59. Ibid.
60. Ibid, at 63.
61. Ibid, art. 16 Protecting Future Generations. See also UN Declaration on the Responsibilities of the Present Generations Towards Future Generations (1997), *supra* note 5, art. 6 Human Genome and Biodiversity and UNESCO Declaration on Science and the Use of Scientific Knowledge (1999), *supra* note 5, at para. 39.
62. See Rio Declaration on Environment and Development (1992), art 3.
63. According to the UNTS database, 149 international treaties contain a reference to the rights of future generations only one of which links them to human health in the context of managing radioactive waste.
64. See UN GA Res 71/313 (2017) 2030 Agenda For Sustainable Development.
65. See e.g., Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997), art 1(ii) and Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998), art. 1.

66. See e.g, Preamble of the Oviedo Convention *supra* note 2, requiring that progress in medicine is used for the benefit of future generations.
67. Aarhus Convention on Access to Information, *supra* note 68.
68. Ibid, art. 1.
69. See Oviedo Convention, Art 28; UNESCO Universal Declaration on Bioethics and Human Rights, Art 18; UNESCO Recommendation on Science and Scientific Researchers, para. 4.
70. UNESCO Declaration on the Responsibilities of the Present Generations Towards Future Generations (1997), *supra* note 5, art. 6.
71. Universal Declaration on Bioethics and Human Rights, *supra* note 2, art. 16 and UNESCO Declaration on Science and the Use of Scientific Knowledge, *supra* note 5, at para. 39.
72. Oviedo Convention, *supra* note 2, Preamble, at para. 1.
73. UNESCO Declaration on Bioethics and Human Rights, *supra* note 2, art 2(h).
74. Ibid, art 16.
75. UNESCO Declaration on the Responsibilities of the Present Towards Future Generations, *supra* note 5, art. 1.
76. Ibid, art 3.
77. UNESCO Declaration on Science and the Use of Scientific Knowledge, *supra* note 5, Preamble, at para. 1.
78. Ibid, at para. 39.
79. UNESCO Recommendation on Science and Scientific Researchers, *supra* note 21, at para. 4.
80. UNESCO, *Birth of the Universal Declaration*, *supra* note 44, Fourth Meeting of the Legal Commission of the IBC, 27 April 1994, at 54.
81. Ibid, Third Meeting, at 50.
82. Aoife Nolan, 'The Children are the Future- Or Not? Exploring The Complexities of the Relationship between the Rights of Children and Future Generations', EJIL:Talk! (2022) https://www.ejiltalk.org/the-children-are-the-future-or-not-exploring-the-complexities-of-the-relationship-between-the-rights-of-children-and-future-generations/#:~:text=Future%20–%20Or%20Not%3F-,Exploring%20The%20Complexities%20of%20the%20Relationship%20between,of%20Children%20and%20Future%20Generations&text=This%20piece%20addresses%20an%20issue,rights%20and%20future%20generations%27%20rights. (accessed August 24, 2023).
83. Sigrun Skogly, 'The Right to Continuous Improvement of Living Conditions and Human Rights of Future Generations – A Circle Impossible to Square?' in *The Right to the Continuous Improvement of Living Conditions: Responding to Complex Global Challenges*, eds. Jessie Hohmann and Beth Goldblatt (Oxford: Hart Publishing, 2021), at 148.
84. Ibid, at 156.
85. See Rumiana Yotova, 'Regulating Genome Editing under International Human Rights Law' *International and Comparative Law Quarterly*, 69 (2020): 653, at 668.
86. *Brüggemann and Scheuten v Germany,* 12 July 1977, DR 10, 100.
87. Michelle Bachelet, 'ONE UN Side event: SDG16 and realising the right to participate – empowering people as agents of more effective climate change', 9 December 2019, https://www.ohchr.org/en/statements/2019/12/25th-session-conference-parties-one-un-side-event-sdg-16-and-realizing-right (accessed August 24, 2023).
88. See e.g., General Comment No 25, *supra* note 3, at para. 37.
89. Cf International Covenant on Economic, Social and Cultural Rights 993 UNTS 3 (1966), art 15(1)(b) and (c). See also CESCR, General Comment No 17 *supra* note 3.
90. Hannah Kuchler, 'Revolutionary CRISPR gene editing speeds from lab to treatment room', 19 August 2022 *Financial Times* at: https://www.ft.com/content/e3c12117-190c-4fc9-9988-57eb9ab9de56 (accessed August 24, 2023).
91. Guidelines on Treaty-Specific Documents to be Submitted by States Parties under Articles 16 and 17 of the ICESCR, ESC (2008), E/C.12/2008/2, 15, at para. 70(a).
92. Report of the Special Rapporteur in the field of cultural rights, Farida Shaheed on 'The Right to Enjoy the Benefits of Scientific Progress and its Applications' A/HRC/20/26 (2012), at paras 26-30.

93. General Comment No 25, *supra* note 3, at para. 17.
94. Ibid, at para. 47.
95. Ibid, at para. 49.
96. Ibid, at para. 66.
97. Ibid, citing Venice Statement, *supra* note 36, at para. 10.
98. Ibid.
99. Ibid.
100. Ibid, at para. 67.
101. Ibid, at para. 80.
102. CESCR, General Comment No. 14: The right to the highest attainable standard of health (2004), E/C.12/2000/4, at para. 12.
103. Ibid.
104. Ibid, at para. 19.
105. UNESCO Declaration on Human Rights and Biomedicine, *supra* note 2, art 2(f).
106. Ibid, art 15(1).
107. Universal Declaration on the Human Genome and Human Rights, *supra* note 2, art 12(a).
108. CBDI, *Preparatory Works of the Oviedo Convention*, *supra* note 61, at 52.
109. Ibid, at 18.
110. Cf Guidelines on Treaty-Specific Documents to be Submitted by States Parties, *supra* note 94, at para. 70(a), CESCR General Comment No 14, *supra* note 105, at para. 12 and Oviedo Convention, *supra* note 2, art 3, Universal Declaration on the Human Genome, *supra* note 2, art 12(a) and UNESCO Declaration on Human Rights and Biomedicine, *supra* note 2, art 2 (f).

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Between Scylla and Charybdis: the implications of the human right to science for regulating the harms and benefits of environmental science and technology

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ABSTRACT

This article explores whether the integration of human rights approaches, in particular, the human right to science in Article 15 (1)(b) of the International Covenant of Economic, Social and Cultural Rights, offers a basis for improving upon current approaches in international environmental law by widening democratic input and oversight in decisions involving environmental science and its applications. It examines a case study regarding the international regulation of marine geoengineering under an amendment to the 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. The analysis focuses on how the harms and benefits of marine geoengineering research are conceived of in the amendment, and the norms and processes adopted to address them. These same issues are then examined under the human right to science, focusing on the recent interpretation of the right by the Committee on Economic, Social and Cultural Rights in its General Comment No. 25. It seeks to show in a particular case how international environmental law and international human rights law each bring to bear different objectives, norms, and processes in how they treat issues of environmental science and technology, and explores the benefits of more integrated approach.

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We then sailed on up the narrow strait with wailing. For on one side lay Scylla and on the other divine Charybdis terribly sucked down the salt water of the sea. Verily whenever she belched it forth, like a cauldron on a great fire, she would seethe and bubble in utter turmoil, and high overhead the spray would fall on the tops of both the cliffs. But as often as she sucked down the salt water of the sea, within she could all be seen in utter turmoil, and round about the rock roared terribly, while beneath the earth appeared black with sand; and pale fear seized my men. So we looked toward her and feared destruction; but meanwhile Scylla seized from out the hollow ship six of my comrades who were the best in strength and in might.

– Homer, The Odyssey[1]

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1. Introduction

The Greek myth of Scylla and Charybdis reminds us that people have always faced dangers from their natural environment, no matter what direction they take. Amongst the many hazards faced on his epic sea voyage, Homer describes Odysseus's dilemma of navigating between Scylla and Charybdis, two immortal and terrifying sea monsters who lurked menacingly on opposite sides of the Strait of Messina between Sicily and Calabria. Scylla, with her six heads filled with sharp teeth placed on long snaking necks and a waist of dog heads, lived on a large rock formation one side of the passage. Charybdis sat on the opposite shore, and took the form of a whirlpool which drank down and belched forth the waters three times daily, and was fatal to shipping.

This mythological story is illustrative of a common dilemma that we face in our modern 'risk society' regarding some emerging environmental science and technology.[2] On the one hand, the cunning of science and technology have provided human societies with powerful means for addressing environmental harms. As ecological threats continue to mount, the stakes in finding new, transformative 'solutions' to environmental problems are also becoming greater. Our faith in scientific and technological progress is not unfounded, being grounded in over a century of historic achievements. In the environmental realm, there are countless examples of how science and technology have produced more environmentally sustainable outcomes, such as improvements in efficiency for conserving the use of energy and natural resources, the generation of renewable energy sources, production of new, less damaging products and materials, and enhancement of environmental monitoring and enforcement capacities.

On the other hand, environmental applications of science and technology may themselves be a source of harm. Rarely, if ever, is there only upside in solving environmental problems through such means. Environmental threats are the products of complex, non-linear interactions between people, their tools, and the environment. Our knowledge and understanding of how environmental threats are produced and the solutions that we devise for addressing them are often incomplete.[3] The uncertainties that cloud emerging science and technologies make assessing potential impacts even more difficult, since knowledge is, *inter alia*, crucial for identifying environmental threats, showing cause and effect relationships, and providing probabilities of risks. Consequently, scientific and technological solutions to environmental problems may generate intended and unintended consequences, creating a new round of 'second order' environmental and social problems.

No one wants to be forced to navigate between two courses of action, both of which are far from ideal. The sense of being caught in an unending cycle dependent on the need to discover, innovate, invent, and intervene in the face of environmental harm, and knowing that the steps we take to prevent such harms may give rise to new ones is deeply unsettling. The solution to Odysseus's seafaring woes lay in minimising the harms from the two competing threats, veering closer to the rocky shoal of Scylla to avoid a complete loss of life on his ship from Charybdis.

A similar challenge exists in the articulation of legal instruments aimed at optimising the harms and benefits of science and its applications. The framing of the harms and benefits of science are typically based on the broader normative and institutional context in which these issues are addressed. Environmental treaties tend to adopt

norms and mechanisms commonly used for other kinds of environmental threats, such as the diligent prevention of environmental harms, precaution, environmental impact assessment, and international cooperation through information sharing. However, even in situations where environmental treaties adopt the most progressive approaches represented in international environmental law to regulating emerging applications of science and technology, they inevitably fall short. A core problem lies in the technocratic orientation of many international environmental law responses with their heavy reliance on environmental decision-making based on scientific and technical advice and evidence. Environmental decision-making is one area that is particularly susceptible to high demands for scientific knowledge, sometimes to the exclusion of other stakeholder and citizen inputs, because of the complex, technical, and uncertain nature of many environmental risks.

Ironically, these are the same conditions which also necessitate that decision-makers consider public perceptions and values in controlling the adverse effects of environmental science and its applications. The social science literature shows, for example, that expert views and assessments do not always align with public concerns associated with emerging science and technologies.[4] It also underscores the importance of upstream citizen involvement beyond experts and technical inputs in order to enhance the social and political responsiveness, democratic legitimacy, and accountability of decision-making in this context.[5] A better understanding of the role of public perspectives and values is especially important regarding the development of more controversial applications of environmental science and technology, since they raise scientific and technological issues which are characteristic of the 'post-normal age' – i.e. where facts are uncertain, values are in dispute, stakes are high, and decisions are urgent.[6] Post-normal science is linked to the need to create spaces for an extended peer community of citizens to serve as 'critics and creators in the knowledge production process'.[7]

Against this backdrop, this article explores whether the integration of human rights approaches, in particular, as embodied in the human right to science set out in Article 15 of the International Covenant of Economic, Social and Cultural Rights (ICESCR),[8] potentially offers a basis for improving upon existing approaches in international environmental law by applying a human rights lens to issues of emerging science and technology, and by widening the basis for democratic input and oversight in various decisions involving environmental science and its applications. The normative link for the integration of human rights and the environment was most recently affirmed by the UN General Assembly with its adoption of a resolution recognising the right to a clean, healthy and sustainable environment as a human right.[9] Legal scholars have begun to analyze the implications of the human right to science for international environmental law given the importance of the science-policy interface for this subject area.[10]

Accordingly, the article will begin by describing a recent example of the regulation of emerging environmental science and technology under the 1996 Protocol (London Protocol, LP)[11] to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention, LC).[12] In 2013, the Contracting Parties to the London Protocol adopted a new amendment on marine geoengineering, which represented the culmination of several years of legal and scientific work by the Contracting Parties in response to a string of public controversies surrounding research

aimed at deliberately modifying natural systems at large scales in order to offset the effects of climate change and other environmental threats.[13] In particular, the analysis will focus on how the harms and benefits of marine geoengineering research are conceived of in the LP amendment, as well as the norms and processes that have been adopted to address them. The article will then examine these same issues through the lens of the human right to science, focusing on the recent interpretation of the right by the Committee on Economic, Social and Cultural Rights (CESCR) in its General Comment No. 25 on science and economic, social and cultural rights.[14] It seeks to show in a particular case how the different areas of international environmental law and international human rights law each bring to bear different objectives, norms, and processes in how they treat issues of environmental science and technology.[15] It also examines the potential advantages of more integrated approach to regulating emerging applications, and some of the challenges that arise in attempting this.

2. The harms and benefits of environmental science and its applications through the lens of international environmental law

2.1. Overview of the LP amendment on marine geoengineering

In a statement of concern issued in 2007, the Contracting Parties of the LC and LP decided that the scope of their work included ocean fertilisation, a marine geoengineering technique that involves adding nutrients to the upper layers of the ocean to stimulate phytoplankton growth to draw down atmospheric carbon dioxide levels.[16] This statement led to further work on these issues, and, ultimately, the establishment an international regulation for ocean fertilisation as well as other marine geoengineering activities that were determined to fall within the scope of the LC and LP and that have the potential to cause harm to the marine environment. This case study examines the scope and content of the 2013 London Protocol amendment on marine geoengineering, in particular, by focusing on how the harms and benefits of marine geoengineering are conceived in the instrument.

The legal basis for expanding the scope of the LP to cover marine geoengineering activities turns on the definition of 'dumping' as 'any deliberate disposal into the sea of wastes and other matter'.[17] Marine geoengineering, which entails the deliberate addition of substances for a specific purpose, such as to address climate change, rather than for the purposes disposal (i.e. getting rid of the substances), would appear to fall outside the scope of the definition of dumping.[18] The LP recognises an exception to dumping for 'placement of matter for a purpose other than the mere disposal thereof' unless contrary to the aims of the LP.[19] However, because of the potential harms to the marine environment from marine geoengineering, these activities were considered by the parties to potentially be contrary to the environmental aims of the LP, and thus fall back within the regulatory scope of the LP in accordance with the wording of the placement exception to dumping.[20]

On this basis, the Contracting Parties to the LP have embraced a much broader mandate centred on a suite of emerging environmental applications of science, primarily based on their potential to cause harm to the marine environment. Their intentions in regulating such activities is reflected in the preamble to the 2103 LP amendment on

marine geoengineering, which expresses their concerns about the potential impacts of marine geoengineering activities on the marine environment, and emphasises their 'determination' to put in place 'a science-based, global, transparent and effective control and regulatory mechanism for such activities'.[21] At present, most marine geoengineering techniques are experimental, or in the demonstration phase of development. The LP amendment on marine geoengineering can therefore be regarded as an instrument which includes within its scope the regulation of emerging environmental science and technologies.

The amendment defines 'marine geoengineering' broadly as 'a deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that have the potential to result in deleterious effects, especially where those effects may be widespread, long lasting or severe'.[22] However, this definition alone does not determine whether a particular marine geoengineering activity will be regulated. Instead, the definition of marine geoengineering, together with other provisions delineating regulatory scope,[23] set out general criteria for determining whether a particular marine geoengineering technique can be added to a new Annex 4 to the amendment, under the so-called 'positive-listing' approach. Only those marine geoengineering activities listed in Annex 4 are subject to regulation, either in the form of an outright prohibition or as a permitting requirement for any activity or subcategory of activity, such as scientific research.[24]

Any marine geoengineering activities subject to a permitting requirement under Annex 4 must also be assessed either under a general assessment framework set out in Annex 5 of the amendment, or a specific risk assessment designed in accordance with the general assessment framework.[25] The general assessment framework is a procedural instrument for evaluating potential effects of the marine geoengineering activity on environment and human health. It provides basis for national authorities, in consultation with other potentially affected states and relevant regional agreements, to decide whether to approve a proposed marine geoengineering activity, including scientific research, based on an assessment of potential physical impacts.[26] In addition, the general assessment framework sets out risk management, monitoring and permitting conditions.

The LP amendment is not yet in force due to a lack of ratifications by states parties. Currently, the only activity listed for regulation in Annex 4 is ocean fertilisation, though the parties are presently considering the addition of other marine geoengineering techniques for regulation.[27] The listing for ocean fertilisation follows previous legally non-binding resolutions adopted in 2008[28] and 2010,[29] which create exception that allows for 'legitimate scientific research' on ocean fertilisation which has been evaluated for its scientific merit and has undergone an environmental assessment to be considered for a permit.[30] All other ocean fertilisation activities are prohibited.[31]

2.2. Meaning of risks and benefits of marine geoengineering in the LP

The meaning of risks and benefits of marine geoengineering in the LP amendment are defined in accordance with the general terms of the treaty, and in its context in light of its object and purpose. As such, the main concern of the LP amendment on marine geoengineering is with the prevention of potential harms, rather than the enhancement of benefits. This emphasis is in keeping with the overarching objectives of the LP as an

environmental treaty aimed at preventing damage to the marine environment from all sources of pollution, and, in particular, by the dumping of wastes and other matter at sea.[32]

Moreover, though the scholarly literature has identified potential harms of marine geoengineering research as also having important social, economic, and justice dimensions,[33] those risks considered under the LP amendment predominately relate to physical impacts on the marine environment, as well as on human health and to other legitimate ocean uses. For example, the definition of 'marine geoengineering' refers to 'deleterious effects', a term which links to the definition of 'pollution' in Article 1(10) of the LP as 'harm to living resources and marine ecosystems, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities'.[34] This focus on physical damage to the marine environment is also indicated by the different factors for evaluating activities under the general assessment framework for marine geoengineering set out in Annex 5 of the amendment. For example, proposed activities including scientific research, are to be assessed relation to their potential effects 'on human health, on marine ecosystem structure and dynamics including sensitivity of species, populations, communities, habitats and processes, amenities and other legitimate uses of the sea',[35] and considering their nature, temporal and spatial scales, and duration. Another example of the focus on physical impacts is the permitting conditions set out in the assessment framework in Annex 5 which stipulate that a decision to issue a permit for a marine geoengineering activity shall only be made if 'it is determined that pollution of the marine environment from the proposed activity is, as far as practicable, prevented or reduced to a minimum, therefore not contrary to the aims of the Protocol'.[36]

The general assessment framework in Annex 5 of the LP amendment also sets out specific considerations related to 'marine scientific research'.[37] This section of the framework identifies different reasons for conducting research, and establishes criteria for assessing research activities which, on the face of it, take a somewhat more expansive view of the kinds of harms connected with marine geoengineering research than merely physical harm to the marine environment. For example, one concern associated with marine geoengineering research that is that it will not be carried out in a competent way, and, as such, will not yield useful research findings and outcomes. This concern arose previously in respect of ocean fertilisation experiments carried out by operators which seemed to lack the necessary scientific and technical expertise in that area.[38] In relation to this concern, the assessment framework requires an evaluation of the project's research objectives, methodologies, and their justification.[39] Proposed research must also adopt appropriate methods, and be subject to scientific peer review at appropriate stages in the assessment process.[40] The need to evaluate the quality of the proposed marine geoengineering research activity can also be linked to the environmental protection objectives of the LP, since this helps to ensure that the knowledge benefits of potentially damaging marine perturbation experiments are more likely to be realised (thus, to some extent justifying potential environmental harms).[41] Another concern related to marine scientific research involving marine geoengineering relates to the potential for conflicts of interests. The assessment framework in Annex 5 of the LP amendment requires an examination of whether economic interests will influence the design, conduct, or outcomes of the proposed marine scientific research activity. In the past, several commercial

operators had made large, but scientifically unsubstantiated claims about the potential efficacy of ocean fertilisation techniques, and had proposed disproportionately large pilot tests (which were thus potentially more damaging to the marine environment) than current scientific knowledge and understanding would rationally justify.[42] As such, scrutiny of whether there is any direct economic gain arising from the experiment or its outcomes not only relates to whether the research findings are independent and credible, but also links to environmental protection goals.

The section on marine scientific research in the general assessment framework in Annex 5 of the LP amendment also highlights some of the benefits of conducting marine scientific research related to marine geoengineering. Again, benefits are framed primarily in terms of the contribution of marine scientific research to environmental protection. For example, this section of the framework states that the purposes of marine scientific research on marine geoengineering include to better understand natural processes, to understand the impact of certain techniques on the marine environment, and to be able to acquire information to inform future assessments of marine geoengineering activities.[43] It also refers to the need to conduct research to understand the potential efficacy of different techniques for geoengineering purposes, which, read in light of the definition of marine geoengineering in the LP amendment, includes to counteract climate change and its impacts.[44] Another provision in the section on marine scientific research includes an assessment of whether the research includes guarantee of on the part of research project proponents that the knowledge be made publicly available in an appropriate and specified time-frame.[45] Such norms requiring the public availability of scientific knowledge are common in international law, and also can promote environmental sustainability in the conduct of scientific research, e.g. by reducing redundancies in sampling conducted at sensitive or popular locations, or the number of interventionist experiments that need to be conducted.[46]

Like most instruments aimed at the prevention of environmental harm, the LP amendment on marine geoengineering has a strong procedural emphasis. This includes reliance on mechanisms such as environmental assessment, notification and consultation as a basis for identifying environmental harms from marine geoengineering activities. A key example is the so-called 'positive-listing' approach for determining the material scope of the regulation, which allows for the addition of new marine geoengineering activities on a case-by-case basis. The advantage of the positive-listing approach is it allows the parties to establish a legally binding framework, whilst also allowing the flexibility to regulate new marine geoengineering activities, including scientific research, as deemed necessary. Since the amendment of annexes is procedurally easier than amending the text of the LP itself, the positive listing approach allows for a more flexible and case-specific approach for the Contracting Parties to decide which marine geoengineering activities should be regulated.[47]

The Contracting Parties have also developed non-binding guidance, which recommends the procedure for consideration of whether to include new marine geoengineering activities of concern to the list in Annex 4.[48] Consistent with the state-centric approach in the international law, however, only Contracting Parties, observer states, and accredited observers may raise activities of concern for consideration for regulation. The procedure does not grant a right to non-state stakeholders or the general public to directly raise a marine geoengineering activity of concern for regulation in the LP. Once

nominated for listing in Annex 4 of the LP amendment, the procedure recommends that the Scientific Groups of the LC-LP should then review information on the scientific and technical considerations of the activity concerned, and should provide advice on the review of the activity, including the robustness of the scientific/technical evidence, and, where appropriate, advise the governing bodies on the level of concern with respect to the activity and the need for further study and further action.[49] The governing bodies are then to review the advice of the Scientific Groups and, 'as appropriate', information on social and economic factors, and take action as necessary.

The guidance procedure also provides that the Scientific Groups and the governing bodies may also seek the input of 'independent international experts' on the proposal for the inclusion of a new marine geoengineering activity for regulation. A second guidance document provides for a roster of 'international independent experts' whom Contracting Parties can consult regarding assessment of currently listed activities or the listing of new activities.[50] Experts can be nominated by Contracting Parties or observers. The guidance document defines 'international expert' as an individual with 'an international repute as an expert, which she has achieved, for example, by subject-related publications in peer-reviewed journals'.[51] The scope of expertise that can be included on the roster includes those with a scientific or technical background in marine sciences or geoengineering, as well as those who can provide advice on the social and economic implications of marine geoengineering proposals.[52]

2.3. Preliminary conclusions on the framing of harms and benefits of environmental science and its applications in environmental treaties

A few observations can be made about how the LP amendment on marine geoengineering conceives of the harms and benefits emerging environmental applications of science and technology.

First, unsurprisingly, the definition of harms and benefits is predominately framed in terms of the overarching aims and objectives and context of the treaty itself. For many environmental treaties, this means that the regulation of applications of science and technology will tend to focus on potential harms with less emphasis on potential benefits. Moreover, the concept of harms may be more narrowly construed in terms of physical impacts on the environment and human health, rather than on other ethical, social, or economic considerations.

Second, in keeping with much of international environmental law, the LP amendment has a strong focus on procedural mechanisms, such as assessment, information sharing, and consultation as a basis for determining harms and benefits of emerging science and technologies. This procedural focus allows for deliberation and potential convergence on controversial questions of substance. On the other hand, the procedural requirements have significant weight in assessing the meaning and scope of harms and benefits of a specific scientific application. For example, determinations of who may participate in the procedure are significant. Environmental treaties tend to place a strong emphasis on the role of scientific and technical experts and expert advice. This role is often institutionalised, e.g., as in the case of the LC-LP's joint Scientific Groups, or as a roster of independent international experts. The overall constitution of these bodies may privilege certain types of knowledge expertise, such as scientific and technical concerns over social,

economic and justice ones, in determining the harms and benefits of science and its applications. Moreover, other non-state stakeholders and the public do not generally have standing to express their views on the regulation of emerging science and technologies in international environmental lawmaking processes. As a result, such processes for deciding about the harms and benefits emerging science and technology are likely to represent a narrower, more technocratic set of values and perspectives.

Third, and related to the above, environmental treaties tends to emphasise the importance of the quality of the science and scientific advice in regulating emerging science and technology, through requirements such as that states parties decide based on the best scientific and technical evidence. Determinations of 'quality' are often made in accordance with the standards set by the scientific community itself, such as whether a publication is peer reviewed or based on the scientific reputation of the scientific experts.

3. The harms and benefits of environmental science and its applications through the lens of the human right to science

As the human right most frequently invoked in relation to science and technology, Article 15(1)(b) of the ICESCR recognises the right of everyone to enjoy the benefits of scientific progress and its applications. Relatedly, states parties to the ICESCR have an obligation to take steps for the conservation, the development, and the diffusion of science,[53] to respect the freedom indispensable for scientific research,[54] and to promote international contacts and cooperation in the scientific field.[55] Though dormant for many decades, the so-called 'human right to science' has received greater attention from scholars and in international documents and statements. In particular, an important development in clarifying of the scope and content of the right to science has been the CESCR's recent General Comment No. 25 on science and economic, social and cultural rights.

This section will examine issues related to the regulation of emerging environmental science and technology, and the example of marine geoengineering specifically, through the alternate lens of the human right to science, focusing especially on the recent interpretation of the right to science in the CESCR's recent General Comment No. 25. It will analyze how a human rights lens affects how the harms and benefits of marine geoengineering are conceived, and, if so, whether there are advantages to adopting a more integrative approach which takes into account the elements of the human right to science in the regulation of emerging science and technologies in environmental treaties.

Before proceeding, however, it is important to clarify that the human right to science does in fact cover all facets of marine geoengineering research, as well as other applications of environmental science and technology. According to the CESCR's General Comment No. 25, Article 15(1)(b) of the ICESCR broadly encompasses all types of scientific research, from basic research, which seeks to advance the frontiers of scientific knowledge, through to more solution-driven 'applied' research directed at addressing practical problems.[56] As such, the right to science clearly applies to marine geoengineering research, which, as noted above, may be conducted for a variety of purposes,

including as applied research aimed at developing measures for offsetting the adverse effects of climate change.

3.1. Meaning of harms and benefits under the right to science

In contrast to environmental treaties, which, as noted above, primarily focus on the prevention of harm, the language of 15(1)(b) of the ICESCR refers to the enjoyment of the benefits of science and its applications. The CESCR's recent General Comment No. 25 indicates that the term 'benefits' has three dimensions: first, the scientific knowledge and information directly deriving from scientific activity; second, the material results of the applications of scientific research, including from technological instruments; and third, the role of science in forming critical and responsible citizens who are able to participate fully in a democratic society.[57] All of these different categories of benefits presumably apply to environmental science and technology, including marine geoengineering research.

However, the CESCR's general description of the benefits in its General Comment No. 25, though useful for broadly delineating the scope of the human right to science, provides only limited guidance for determining whether science and its applications constitute a benefit in a particular case. Like environmental treaties, the right to science takes a procedural turn with regard to how the benefits (and harms, as discussed below) of particular scientific applications are ultimately defined. In particular, this determination is made through the recognition of a specific right to participate in scientific progress under the human right to science. In contrast to international environmental law, however, the right to participate in scientific progress is extended to all members of society, not just scientists themselves. As such, the question of 'who' has the power to define the scope of harms and benefits of science and its applications, and how they ought to be distributed that the human rights approach can most clearly be distinguished from environmental treaties such as the LP.

3.2. Rights and responsibilities of scientists in determining the harms and benefits of science

Recognising a greater role for other societal actors in determining the harms and benefits of science and its applications under the human right to science does not necessarily diminish that of members of the scientific community in promoting scientific progress in accordance with this right. Even the most severe critics of technocratic approaches recognise that expert knowledge and competence can greatly improve outcomes and enhance public welfare, including in relation to the protection of the environment.[58] Scientists' role in the global governance of science is far reaching, as noted in one report commissioned by the European Commission:

> [Scientists] regulate the production of knowledge by, for example, structured experimentation, systematic model construction, simulation and other methods. They control what counts as knowledge, through peer review and replication. And they manage how science is communicated by means of conference presentations and professional publications. In addition, scientists heavily influence processes of research funding through peer review

> and grant panels, and they guide decisions about the hiring and promotion of fellow scientists.[59]

The role of scientists is also elaborated in the normative content of the right to science. For example, the CESCR's General Comment No. 25 indicates that 'quality' constitutes a cross-cutting element of the human right to science, a term defined as 'the most advanced, up-to-date and generally accepted and verifiable science available at the time, according to the standards generally accepted by the scientific community'.[60] As a corollary, States have a duty 'to rely on widely accepted scientific knowledge, in dialogue with the scientific community, to regulate and certify the circulation of new scientific applications accessible to the public'.[61] This aligns with provisions in environmental treaties, including the LP amendment on marine geoengineering, which emphasise that decision-making should reflect the best available scientific knowledge and technology. In international environmental processes, the involvement of scientific experts helps to frame environmental issues and regulatory objects, influence choices between different analytical models or methodologies, and evaluate environmental risks and the measures that should be taken to address them.

However, it is also important to note that under the right to science responsibility for ensuring quality of scientific knowledge and know-how does not solely rest with members of the scientific community. For example, the CESCR's General Comment No. 25 indicates that states also have duty to ensure quality, including through 'regulation, and certification as necessary, to ensure the responsible and ethical development and application of science'.[62] In this sense, the LP amendment on marine geoengineering is a good example of states implementing their obligations under Article 15(1)(b) of the ICESCR by asserting standards of scientific quality in an environmental context. For example, the LP amendment requires that Contracting States evaluate marine scientific research activities according to their objectives, motivations, appropriateness of methodologies, that they ensure that peer review occurs at appropriate stages of the research process, and that they consult independent international experts as part of their decision-making process.[63]

However, the duty of states to ensure the 'responsible and ethical development and application of science' under the human right to science is more far-reaching in scope than merely guarding against physical harm to the environment and human health from emerging science and technology. The narrower basis for the framing of harms and benefits of marine geoengineering in the LP amendment raises the important question of whether states parties to the LP, have fully discharged their duties in a human rights context where broader social, economic, politics and ethical considerations may be at stake.

3.3. Rights of the public in determining the harms and benefits of science

As mentioned above, it is regarding the question of 'who' ought to have a stake in defining the harms and benefits of science and its applications that the right to science has the potential to distinguish itself most clearly from approaches commonly adopted in the regulation of emerging environmental science and technology in international environmental law. Whilst environmental treaties like the LP amendment on marine

geoengineering tend to emphasise the role of experts in providing quality scientific knowledge and advice to decision-makers on the harms and benefits of science and its applications, the right to science regards these determinations as being more participatory and inclusive to all members of society. Overall, the human right to science seeks to enhance public opportunities to influence scientific progress, and to ensure the conditions that enable the public to form an accurate conception of their perspectives and values, and to gain knowledge of how to promote them, through principles of transparency, public participation in decision-making, and non-discrimination.

This interpretation of the right to science is partly derived from the recognition of the human right to science as part of the corpus of cultural rights generally. The CESCR indicates in its General Comment No. 21 on the right of everyone to take part in cultural life that 'culture' refers 'a broad, inclusive concept encompassing all manifestations of human existence'.[64] It further states that the 'full promotion of and respect for cultural rights is essential for the maintenance of human dignity and positive social interaction between individuals and communities in a diverse and multicultural world'.[65] The human right to science enshrined in Article 15(1)(b) of the ICESCR is therefore closely related to the other cultural rights.[66] It not only encompasses a right of everyone to receive material benefits or products of science generated by professional scientists, but also includes a right of all members of society to participate in scientific progress in their own right.[67] This interpretation also flows from the *travaux préparatoires* for the drafting of Article 15 of the ICESCR, which indicates that the article was intended to develop Article 27 of the Universal Declaration of Human Rights,[68] which recognises not only a right to receive the benefit of science, but also to participate in scientific progress more directly.[69]

Accordingly, the specific right to participate in scientific progress pursuant to Article 15(1)(b) of the ICESCR implies not only negative, but also positive obligations for states to create an enabling and participatory environment for the conservation, development and diffusion of science and technology without discrimination.[70] It also entails that that states parties 'provide opportunities for public engagement in decision-making about science and technology and their development'.[71] In addition, guarantees of access to information also are also necessary for the effective participation of members of society in the conservation, development and diffusion of science and technology. The CESCR's General Comment No. 25 stipulates, in particular, that information concerning the risks and benefits of science and technology should be accessible without discrimination.[72]

The recognition of procedural rights to information and to participate in scientific progress has the potential to improve the efficacy, democratic legitimacy, and accountability of decision-making related to science and technology, including in an environmental law context. Generally, the right to information is regarded as necessary to enable members of the public to participate meaningfully in public affairs and to make decisions about their lives. It also plays a role in facilitating and enabling meaningful public participation in decision-making. A right of public participation helps the public realise its potential to take part in public affairs, and it also has the potential to improve the outcomes of policy and decision-making by bringing information, analysis, and other considerations to bear. Participation also increases the likelihood that

decisions will be implemented with the support and participation of the interested public. It helps to build capacities, empower citizens, legitimises a government's rule and the role of stakeholders and builds public confidence and public trust. It can also help with conflict resolution.[73]

3.4. The right to be protected against the harms of science and its applications

The question of whether the right to science includes a general right to be protected against the adverse effects of science has been controversial. Though this element has been endorsed by most scholars and various reports and statements, the CESCR's recent General Comment No. 25 did not address this element in depth. Rather than explicitly recognising a general right to be protected against the adverse effects of science and its applications (and correlative duties on states parties to protect), the CESCR appears to interpret the right in a more limited procedural form as part of the rights to information and to participate in controlling the adverse effects of science and its applications.[74]

It is arguable that the CESCR's lack of recognition of a general right to be protected against the adverse effects of science and its applications constitutes a missed opportunity by limiting the responsibilities of states and other societal actors to prevent environmental harms from applications of science and technology. The rights of the public to have access to information, and to participate in deliberations about the adverse effects of science and technology are procedural, and, as such, do not require that the substantive content of decisions about science and its application actually reflect public views about harms and benefits. States parties to the ICESCR would therefore not be responsible for failing to protect against the adverse effects of science and technology, absent a procedural violation.

On the other hand, even the more limited guarantee of procedural rights to information and participation in relation to the adverse effects of science and technology is clearly a step in the right direction, since this is arguably more than what most states parties currently provide for in a national context. The CESCR's General Comment No. 25 states that one of the core obligations of states parties under the right to science requires that they 'develop a participatory national framework law on this right that includes legal remedies in case of violations, and adopt and implement a participatory national strategy or action plan for the realisation of this right that includes a strategy for the conservation, the development and the diffusion of science'.[75] Implementation of this requirement could go a long way in enhancing the efficacy, democratic legitimacy, and accountability of decision-making related to the adverse effects of environmental science and its applications.

The legal recognition of procedural rights to information and access to information under the right to science overlaps with similar rights recognised in international environmental law. The rights to information and public participation in environmental matters are widely considered central pillars of good environmental and sustainable governance in accordance with Principle 10 of the Rio Declaration,[76] and developed other instruments such as the Aarhus Convention.[77] UNEP has developed guidance in its 2015 Bali Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters.[78]

The scope of the rights to information and participation in environmental matters as indicated in the Bali Guidelines are generally broad enough to include the environmental risks associated with science and technology. However, because specific standards and practices on how the right to science should be implemented are yet to be developed, it is possible that the scope and content of the procedural rights recognised in relation to the human right to science and under international environmental law may differ somewhat. For example, in the context of environmental rights, the access to environmental information employs the 'any person' principle, whereas public participation in environmental decision-making is limited to the 'public concerned', i.e., members of the public with a particular stake or interest in the decision-making process. The meaning of the 'public concerned' can also vary depending on the type of decision-making and the subject.[79] By contrast the 'public concerned' regarding the right to participate under human right to science is broader, and arguably includes all citizens.[80]

Another key question related to the integration of the human right to science in environmental treaties is how a right of participation should be interpreted and applied in relation to the risks of science and technologies that are transboundary or global in nature. The issues are neatly summed up by Faik Kurtulmuş in his chapter on the 'Democratization of Science',

> despite all the changes brought on by decades of globalization, contemporary democracy operates at the level of the nation-state. Science, however, is a global enterprise. Even though much of it is done in affluent parts of the world, it affects the entire world population. Therefore, the argument from impact suggests a global extension of the democratization of science.[81] Science produced in the affluent parts of the world also figures in policy making in the rest of the world through the transfer of research among scientists and through international organizations like the World Bank, the IMF, and the WHO. Thus, the argument from collective self-government also reaches beyond the nation-state. How to carry out such an extension in practice remains a challenge for the democratization of science.[82]

The CESCR's General Comment No. 25 acknowledges that 'the most acute risks to the world related to science and technology … are transnational', mentioning first and foremost environmental threats, such as climate change and the rapid loss of biodiversity.[83] It further states that one means to address these risks is through the duty of international cooperation in relation to the right to science, specifically that 'states should promote multilateral agreements to prevent these risks from materializing or to mitigate their effects'.[84] However, the CESCR does not suggest that individuals and groups (as non-state actors) should enjoy a direct right to participate in controlling transboundary and global risks of science and technology.[85] In this way, the CESCR's interpretation of the right to participation under the human right to science merely defaults to the *status quo* in international environmental law, where the exchange is still primarily between states, intergovernmental organisations, and NGOs with observer status.[86] In general, the rules and principles for participation in international environmental processes are set by the institution itself, and vary on a case-by-case basis.[87] However, members of the general public as non-state actors do not have a general right to participate in international environmental lawmaking and deliberative processes relating to emerging science and technology.[88]

The LP amendment on marine geoengineering is therefore but one example of an environmental treaty which regulates the risks and promises of new and emerging environmental science and technologies primarily through deliberations by states and international organisations and accredited observers which include some NGOs. As discussed above, scientific and technical experts also play a key role in decision-making related to the risks of marine geoengineering research under the LP amendment, such as in relation to the assessment of risks and the listing of new marine geoengineering techniques for regulation. However, it does not provide for any right of members of the general public to participate in deliberative lawmaking processes on the risks and benefits of marine geoengineering.

There is therefore a mismatch regarding the recommendations in the scholarly literature which detail the importance of public input in decision-making about the adverse effects of science and technologies, the widespread recognition that most of our most acute risks from science and technology span across borders,[89] and the lack of standing of individuals and groups to participate directly in international lawmaking processes, including concerning the environment. Unfortunately, the CESCR's General Comment No. 25 on the right to science has not really changed this situation, despite ambition in other fora to extend rights of access to information and public participation to the international level.[90]

Even with a change in international rules to allow private individuals and groups greater access to international lawmaking processes relating to the harms and benefits of science and technology, there would be an issue of how to effectively design and implement such processes. Whereas a right to information is in principle relatively simple to implement internationally in the internet age, through online clearing house mechanisms and other information repositories, a right of the general public to participate in deliberations over global risks is not. It is not clear that mechanisms developed to allow for more direct participation in science and technology development, such as citizen juries, consensus conferences, deliberative polls, and participatory technology assessment scale particularly well at international level.[91] One of the issues relates to how broadly the right to participate should be construed in light of practical difficulties surrounding implementation, capacity, and resource constraints. For example, for marine geoengineering technologies directed at offsetting the effects of climate change deployed in high seas areas. the interested public is arguably 'everyone in the world' given the global nature of the issues. However, creating an appropriate forum to include the general public would be challenging, and would may drawbacks, such as decreasing the efficiency and ability to reach international agreement.[92]

Though it is beyond the scope of this article to develop a comprehensive approach for overcoming these issues, there are at least three ways in which the implementation of the right to science, as currently interpreted by the CESCR, could still allow for greater public involvement in environmental decisions about science and technology at the international level.

First, as mentioned above, the CESCR indicates in its General Comment No. 25 that that states parties must put in place a normative framework that ensures the full enjoyment of the right to participate in and to enjoy the benefits of scientific progress and its applications, without discrimination, and that creates an enabling and participatory environment for the conservation, the development and the diffusion of science and

technology. The development of this framework at the national level could also assist government authorities in gathering the input of citizens on emerging science and technology which has transboundary or global implications, and this information could then be integrated into the positions of that state in relevant international decision-making processes. For example, Environment and Climate Change Canada in partnership with the Department of Fisheries and Oceans could use citizen input on the development of marine geoengineering technologies in informing its policy positions in the LP, and other environmental bodies such as the UNFCCC.

Second, international institutions with a role in decision-making about emerging science and technology should strive to be more inclusive and representative of a wide range of disciplinary and interdisciplinary views. Greater collaboration across disciplines allows for the integration of knowledge with a human perspective which are critical to the comprehensive understanding of the problems and solutions to environmental sustainably.[93] From a normative perspective, the CESCR's General Comment No. 25 indicates that the right to 'science' under the right to science is broad, and encompasses natural and social sciences.[94] As such, the requirement that states parties to the ICESCR 'adopt mechanisms aimed at aligning government policies and programmes with the best available, generally accepted scientific evidence' presumably includes the full spectrum of disciplinary and interdisciplinary knowledge about the potential harms and benefits of environmental science and technology.[95] Openness to including a wider set of disciplinary risk perspectives – supplementing 'hard' scientific and technical expertise with social science, humanities and other disciplinary knowledge – has the potential 'to enhance the quality and inclusiveness' of risk decision-making processes about emerging environmental science and technology and to 'make the results more acceptable to a wider range of audiences'.[96] To implement this element of the human right to science, the LP amendment could develop broader and more explicit guidance about the types of disciplinary expertise that is relevant and should be taken into account decision-making about the harms and benefits of marine geoengineering. The requirement to consider scientific and technical information is more firmly entrenched in norms and procedures for deciding about marine geoengineering under the London Protocol, than in relation to social science and humanities research.

Third, the human right to science calls for international cooperation on decision-making related to science and technology with potential harms and benefits that extend beyond national borders. The LP amendment on marine geoengineering is an example of international cooperation in action. However, greater attention could be paid to the equitable distribution of the risks and benefits between developed and developing countries, also a key aspect of international cooperation under the human right to science.[97] This would not be difficult, since like many environmental treaties, the LP provides for technical cooperation and assistance for the prevention, reduction, and, where practicable, elimination of pollution caused by dumping, including 'access to and transfer of environmentally sound technologies and corresponding know-how, in particular to developing countries and countries in transition to market economies, on favourable terms, including on concessional and preferential terms, as mutually agreed'.[98]

4. Conclusion

The backstory to the myth of Scylla and Charybdis is revealing in that it shows how the environmental threats faced by Odysseus and his crew were in fact 'made' by the gods of Homer, who though incomparably powerful and immortal, were much like mortals in that their actions were susceptible to the same kinds of human desires and failings. Similarly, today, we have come to understand the catastrophic environmental consequences that we face as largely the product of human action and influence. The threats of climate change, mass extinctions, widespread degradation of the global ocean, are thus examples of human entanglement with nature, and our processes of science and innovation in particular. In this sense, our degraded global environment is a monster of our own making, and reflects our own moral and other failings in the exercise of our profound scientific knowledge and technological power.

In his reading of *Frankenstein* in his essay 'Love your Monsters: Why We Must Care for Our Technologies as We Do Our Children', the late Bruno Latour, one of the founders of science and technology studies, argued that our true sin is the lack of care and concern that we show for science and technology:

> We blame the monster, not the creator, and ascribe our sins against Nature to our technologies. But our iniquity is not that we created our technologies, but that we have failed to love and care for them. It is as if we decided that we were unable to follow through with the education of our children.[99]

There is clearly a role for international law in ascribing more care to how we discover, innovate, invent, create, and intervene in the service of our natural environment, especially given the ways in which science and technology transcend national borders in our increasingly globalised world. This article shows how the fragmentation of international law constitutes a barrier to fully realising the potential of international regimes in ensuring greater effectiveness, public trust, equity, and accountability in the way environmental science and its applications are developed and used. The different areas of international environmental law and international human rights law both bring to bear different objectives, norms and processes in how they treat issues of science and technology. Neither is perfect. Systemic integration of international law may open possibilities for navigating a more ideal route for the regulation of new and emerging technologies by exposing a wider range of normative choices in how laws and regulations are conceived. However, we must also pay attention to the specific ways in which these areas of international law may be incompatible or in conflict, or repeat the same kinds of failures in different areas.

The science-policy interface is dynamic and constantly evolving. The environmental sciences are in a process of transformation driven by demands for knowledge solutions that are better suited to steering socio-ecological systems towards a more sustainable path, and that reflect cooperation of different scientific domains, decision-makers and society at large.[100] With further clarification of the scope and content of the human right to science, including through the CESCR's recent General Comment No. 25 on science and economic, social and cultural rights, environmental treaties should begin a process of deliberation on how the elements of this human right could be better reflected in their legal and institutional responses to environmental science and

technology. In this respect, this article has only scratched the surface of how the human right to science could influence how environmental science and technology are addressed in international processes. For example, it has not discussed how the existence of 'deep international disparities' among countries in scientific knowledge production factor into the distribution of 'risks' and 'benefits' of environmental science and technology under international law. There are also equitable elements to the duty to cooperate under the human right to science,[101] which could be better protected in international environmental law.

Notes

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9. UN General Assembly, Resolution 76/300, The human right to a clean, healthy and sustainable environment, UN Doc. A/RES/76/300, 1 August 2022.
10. Elsa Morgera, 'The Relevance of the Human Right to Science for the Conservation and Sustainable Use of Marine Biodiversity of Areas beyond National Jurisdiction: A New Legally Binding Instrument to Support Co-Production of Ocean Knowledge across Scales', in *International Law and Marine Areas Beyond National Jurisdiction: Current Status and Future Trends*, eds. V. De Luca, L. Nguyen and A. G. Oude Elferink (Leiden: Brill, 2022); Anna-Maria Hubert, 'The Human Right to Science and its Relationship to International Environmental Law', *The European Journal of International Law* 31, no. 2 (2020); Jacqueline Peel, 'The "Rights" Way to Democratize the Science–Policy Interface in International Environmental Law? A Reply to Anna-Maria Hubert', *The European Journal of International Law* 31, no. 2 (2020).
11. Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1996) 36 ILM 1 ('London Protocol').

12. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) 11 ILM 1358 ('London Convention').
13. London Convention and London Protocol, 'Report of the Thirty-Fifth Consultative Meeting and the Eight Meeting of the Contracting Parties', UN Doc LC 35/15, 21 October 2021, Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities (adopted on 18 October 2013), ('Resolution LP.4(8)').
14. Committee on Economic Social and Cultural Rights (CESCR), 'General comment No. 25 (2020) on science and economic, social and cultural rights (article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights)', UN Doc. E/C.12/GC/25, 20 April 2020 ('General Comment No. 25').
15. This analysis focuses narrowly on the LP amendment on marine geoengineering. However, it should be noted that this topic has been addressed by other environmental treaties, including through a series of COP decisions under the Convention on Biological Diversity (CBD). These provide a different normative basis for addressing these issues, which may be more compatible with the human right to science. For example, the CBD's scientific and technical cooperation in this area includes consideration of 'the views and experiences of indigenous and local communities and other stakeholders, on the possible impacts of geoengineering techniques on biodiversity and associated social, economic and cultural considerations, and options on definitions and understandings of climate-related geo-engineering relevant to the Convention on Biological Diversity'. See further CBD, 'Climate-related Geoengineering and Biodiversity', https://www.cbd.int/climate/geoengineering/.
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17. London Protocol, Article 4.1.1. See also United Nations Convention on the Law of the Sea (adopted 10 December 1982, entered into force 16 November 1994) 1833 *UNTS* 3 ('LOSC'), Article 237 which allows for the conclusion of further agreements which related to the protection and preservation of the marine environment, which 'should be carried out in a manner consistent with the general principles and objectives of [the] Convention'.
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19. London Protocol, Article 4.2.2.
20. See London Protocol, Article 2, which states: 'Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonize their policies in this regard'. Confirmation of this interpretation can be found in the language of the London Protocol amendment on marine geoengineering itself. For example, London Protocol, Article *6bis* states that 'Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in annex 4, unless the listing provides that the activity or the subcategory of an activity may be authorized under a permit'.
21. Resolution LP.4(8), preamble. This phrasing echoes previous legally non-binding decisions taken by States Parties to the Convention on Biological Diversity. See CBD, Decision X/33, 'Biodiversity and Climate Change' (19 December 2010) UN Doc UNEP/CBD/COP/10/27.
22. Resolution LP.4(8), Article 5*bis*. This definition incorporates the essential elements of The Royal Society's definition of geoengineering: namely, the intentional nature of the activity, the scale of the intervention, and, relatedly, the potential to cause deleterious effects on the marine environment. See John Shepherd et al., *Geoengineering the Climate: Science, Governance and Uncertainty* (London: Report 10/09, The Royal Society, 2009) (The Royal Society Report on Geoengineering) 1.

23. Resolution LP.4(8), Art 6*bis*(1). In addition, in order to be considered for a listing in Annex 4, the technique must also fall within the scope of the London Protocol as the introduction of matter into the sea with the potential to cause harm to the marine environment. See London Protocol, Articles 4.1 and 4.2.
24. Resolution LP.4(8), Article 6*bis*.
25. Resolution LP.4(8), Annex 5.
26. Annex 5, Resolution LP.4(8), Annex 5, paras. 7–9, of the general assessment framework set out special considerations for assessing marine scientific research related to marine geoengineering.
27. London Convention and London Protocol, 'Marine Geoengineering**:** Updated advice from GESAMP Working Group 41 to the London Protocol Parties to assist them in identifying marine geoengineering techniques that it might be prudent to consider for listing in the new annex 4 of the Protocol, Note by the Secretariat' UN Doc LC/SG 45/3 (7 January 2022).
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29. London Convention and London Protocol, 'Resolution LC-LP.2(2010) Assessment Framework for Scientific Research Involving Ocean Fertilization'(11–15 October 2010).
30. Resolution LP.4(8), Article 6*bis*.
31. Ibid.
32. London Protocol, Article 2 states that 'Contracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonise their policies in this regard'.
33. GESAMP has established a working group whose mandate includes to study the potential social and economic impacts of different marine geoengineering approaches on the marine environment. In addition to marine scientists and engineers, the working group is comprised of social science experts, including those in environmental economics. See GESAMP, *High Level Review of a Wide Range of Proposed Marine Geoengineering Techniques* (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UN Environment UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, Rep. Stud. GESAMP No. 98, 2019), http://www.gesamp.org/publications/high-level-review-of-a-wide-range-of-proposed-marine-geoengineering-techniques. See also National Academies of Sciences, Engineering, and Medicine, *A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration* (The National Academies Press, 2022) https://doi.org/10.17226/26278.
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35. Resolution LP.4(8), Annex 5, para. 17.
36. Resolution LP.4(8), Annex 5, para. 26.7.
37. Resolution LP.4(8), Annex 5, para. 7–8.
38. Hubert, 'Marine Scientific Research and the Protection of the Seas and Oceans'.
39. Resolution LP.4(8), Annex 5, para. 8.
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41. Hubert, 'Marine Scientific Research and the Protection of the Seas and Oceans'.
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43. Resolution LP.4(8), Annex 5, para. 7.
44. Ibid.
45. Ibid., para. 8.
46. Hubert, 'Marine Scientific Research and the Protection of the Seas and Oceans'.

47. The amendment of annexes to the London Protocol is regulated under London Protocol, Article 22.
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50. London Convention and London Protocol, 'Report of the Thirty-Sixth Consultative Meeting and the Ninth Meeting of the Contracting Parties', UN Doc. LC 36/16, 7 November 2014, Annex 4, 'Description of Arrangements for a Roster of Experts on Marine Geoengineering in the Consultation Process' (with regard to paragraph 12 of Annex 5 to the London Protocol).
51. Ibid., para. 7.
52. Ibid., Annex 1.
53. ICESCR, Art. 15(2).
54. ICESCR, Art. 15(3).
55. ICESCR, Art. 15(4).
56. According to General Comment No. 25, para. 7, 'applications' refers to 'the particular implementation of science to the specific concerns and needs of the population. Applied science also includes the technology deriving from scientific knowledge … '.
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58. Faik Kurtulmuş, 'The Democratization of Science', in *Global Epistemologies and Philosophies of Science*, eds. David Ludwig et al. (London: Routledge, 2021).
59. European Commission, 'Global Governance of Science: Report of the Expert Group on Global Governance of Science to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission' EUR 236161 (2009), https://op.europa.eu/en/publication-detail/-/publication/74f6f66b-d6f0-4100-b052-89d1c1265871.
60. General Comment No. 25, para. 18.
61. Ibid.
62. Ibid.
63. Resolution LP.4(8), Annex 5, para. 8. Issues related to the quality of the scientific evidence and advice may also overlap with concerns of environmental harm since research that is not conducted according to high scientific standards may cause environmental damage. Research that does not meet the standards of the scientific community may also not produce the same degree of benefits, since the data and results may be in question.
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83. General Comment No. 25, para. 81.
84. General Comment No. 25, para. 81.
85. See Mülller, in this edition.
86. See Jutta Brunnée and Ellen Hey, 'Transparency and International Environmental Institutions', in *Transparency in International Law*, eds. Andrea Bianchi and Anne Peters (Cambridge: Cambridge University Press, 2013) explaining, 'Instruments generally require NGOs to show that they have expertise or an interest in the subject matter of the body concerned, and subject NGO participation to the approval of its member States'. For a more in depth examination of democratic representation and participation in international organizations and international lawmaking, see Samatha Besson, 'Democratic Representation within International Organizations: From International Good Governance to International Good Government', *International Organizations Law Review* 19 (2022), 489–527; Samantha Besson and José Luis Marti, 'Legitimate Actors of International Law-Making – Towards a Theory of International Democratic Representation' 9(2018): 3 *Jurisprudence,* 9, no. 3 (2018).
87. *Ibid.:* 'The regular mode of proceeding in most [international environmental institutions] is that all State parties and a large number of observers, including non-member States, intergovernmental organizations and non-State actors, such as NGOs, are permitted to participate in COPs and the meetings of subsidiary bodies, including bodies of limited composition. Instruments generally require NGOs to show that they have expertise or an interest in the subject matter of the body concerned, and subject NGO participation to the approval of its member States'.
88. See Alan Boyle and Casey McCall-Smith, 'Transparency in International Lawmaking' in *Transparency in International Law*, eds. Andrea Bianchi and Anne Peters (Cambridge: Cambridge University Press, 2013) noting that 'despite the prevalence of NGOs in UN forums, it is difficult to talk in general terms about a "right" to participate' in the process of international lawmaking.'
89. On the importance of international democratic representation for participation, see Samatha Besson, 'Democratic Representation within International Organizations: From International Good Governance to International Good Government', 19 *International Organizations Law Review,* 19 (2022), 489-527; Samantha Besson and José Luis Marti, 'Legitimate Actors of International Law-Making – Towards a Theory of International Democratic Representation', (2018) 9:3 *Jurisprudence,* 9, no. 3 (2018).
90. There has been some ambition to change the status quo. For example, states parties to the Aarhus Convention, decided to actively promote the application of the Convention's

principles in other international forums. They called for the further development of policies and procedures on access to environmental information and 'transparent and clearly stated standards' for public participation in 'all relevant stages of the decision-making process' in international environmental institutions. See Jonas Ebbesson, 'Global or European Only? International Law on Transparency in Environmental Matters for Members of the Public', in *Transparency in International Law*, eds. Andrea Bianchi and Anne Peters (Cambridge: Cambridge University Press, 2013).

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97. See General Comment No. 25, para. 79.
98. London Protocol, Article 13.
99. Bruno Latour, 'Love your Monsters: Why We Must Care for Our Technologies as We Do Our Children', *Breakthrough Journal* 2012. https://thebreakthrough.org/journal/issue-2/love-your-monsters.
100. Patric Brandt et al., 'A Review of Transdisciplinary Research in Sustainability Science' *Ecological Economics* 92, August (2013).
101. See General Comment No. 25, para. 79.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Anticipation under the human right to science (HRS): sketching the public institutional framework. The example of scientific responses to the appearance of SARS-CoV-2

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ABSTRACT

This contribution sketches the domestic and international institutional framework that states shall set up to implement their anticipation duties flowing from the HRS and, at the same time, enable international organisations to comply with their anticipation responsibilities for the HRS. Building on the understanding of science as a communal and open-ended endeavour of knowledge seeking in which everyone has an equal right to participate, to benefit from and to be protected against harm arising from it, it elaborates on states' duties under the HRS to anticipate both the (opportunities for) benefits and the (risks of) harm of science, and to promote the former and protect against the latter with due diligence. It then argues that the HRS requires domestic and international institutions working along egalitarian lines and allowing for broad participation to (co-)specify domestic anticipation duties and coordinate their implementation in context. This is essential due to the global nature of many harms and benefits of science and its communal character. The example of the scientific response to SARS-CoV-2 is used to highlight that the current domestic and international institutional framework has, however, serious shortcomings.

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1. Introduction

This contribution argues that the biggest obstacle to the realisation of the human right to science (HRS),[1] including in particular the right to participate in and enjoy the benefits of science and its applications and the right to be protected against the adverse effects of science and its applications,[2] is the wide-ranging direct or indirect[3] privatisation and commercialisation of the scientific enterprise[4] as well as other pervasive forms of instrumentalisation of science. The direct or indirect privatisation appears to extend to many components of the current domestic and international institutional framework that states have set up to secure the HRS, including their anticipation duties flowing from it in the

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area of health and medical research and science. This seems to lead to a situation today in which scientific processes and research as well as their outcomes, benefits and applications are often directed, exploited, and otherwise influenced by powerful commercial and other private interests.[5] Similarly, knowledge and information about the short- and long-term harm (or risks thereof) of scientific processes, applications and technologies are largely in the hands of private entities. At the same time, the indirect privatisation of 'public' institutions can result in the unfortunate misuse or instrumentalisation of science (or, rather, what is deemed to be 'science' or a 'scientific consensus', expressed for example in the often-repeated slogan 'follow *the* science'[6]) and technology to justify technocratic-managerial, top-down approaches to govern and control local, regional and global societies to allegedly ensure 'public health', 'prevent terrorism' and offer 'security', implement the Sustainable Development Goals (SDGs), etc. Such approaches are adopted by domestic, regional and international institutions which technically remain public institutions, but which, to varying degrees, may have come under the influence of powerful private actors.[7] More broadly, this reality can undermine individuals' enjoyment of human rights other than the HRS, as well as the functioning of domestic democratic institutions through which states shall respect, protect and fulfil these rights.[8]

The (negative) example of the ongoing global distribution of investigational vaccines against Covid-19 that are based on a novel gene-based mRNA technology[9] hailed as the 'breakthrough of science of the year 2020'[10] via domestic and international institutions to allegedly rid the world of the in all likelihood engineered[11] SARS-CoV-2 virus whilst at the same time supressing effective early treatment protocols based on re-purposed drugs[12] is used to illustrate the shortcomings of this largely privatised existing institutional framework to realise the HRS. The focus is on the dysfunction of the institutional framework to enable the implementation of states' duties to anticipate the (risks of) harm and (opportunities for) benefits of (medical) science, as well as the implementation of international organisations' anticipation responsibilities for the HRS. This is used as a basis for sketching some of the potential features that a reformed institutional framework, including a reformed World Health Organization (WHO), should probably have, grounded in the HRS. Among them are features that ensure the public nature of the institutional framework allowing for democratic control over the entire scientific enterprise, including, where necessary through extensive cooperation and coordination of the (domestic) specification of state anticipation duties and their allocation and implementation through international institutions that 'work along egalitarian lines'.[13]

The analysis proceeds in four steps. Section 2 summarises scientific developments around the appearance of SARS-CoV-2 in late 2019, resulting in the development and global promotion and distribution of investigational Covid-19 vaccines through the existing institutional framework comprising domestic, European (European Medicines Agency (EMA)) and global (WHO) medical (quasi-[14])regulators and the *Covax*[15] distribution network, a public-private partnership (PPP) run jointly[16] by the WHO, the Vaccine Alliance *Gavi* and the Coalition for Epidemic Preparedness Innovation (*Cepi*).[17] It also highlights the deficits of this partly privatised institutional framework to secure everyone's HRS. Taking a step back to set the scene for an analysis of the desirable features of a reformed institutional framework, section 3 summarises the understanding of science as a communal and participatory endeavour that underlies the

three-pronged scope of the HRS. Section 4 elaborates on states' corresponding duties and international organisations' responsibilities flowing from the HRS to anticipate both the benefits and harm of science, and to promote the former and protect against the latter with due care. Section 5 examines (some of) the features that a (reformed) institutional framework should possibly have to enable state duty-bearers and international organisations as responsibility-bearers to effectively discharge these anticipation duties and responsibilities. This is done *inter alia* by relating the analysis back to the example of the institutional shortcomings introduced in section 2. Section 6 concludes.

2. The current dysfunctional institutional framework to anticipate the harm and benefits of science: the example of scientific responses to the appearance of SARS-CoV-2

In January 2020, the WHO classified the appearance of SARS-CoV-2 as a Public Health Emergency of International Concern (PHEIC) under the International Health Regulations (IHR).[18] Despite the low average infection fatality rate (IFR) of the illness Covid-19 caused by SARS-CoV-2 that was clear early on,[19] the WHO upheld the Covid-19-PHEIC for more than three years until the 5th of May 2023.[20] The existence of the Covid-19-PHEIC justified the recommendation of far-reaching emergency medical and non-medical countermeasures,[21] and in particular the rapid development, global distribution and mass administration of investigational vaccines. Many of the WHO's recommendations were contrasting long-accumulated public health wisdom on pandemic response found *inter alia* in WHO documents,[22] as they were now expressed in the language of and dominated by the approach of the Global Health Security (GHS) doctrine.[23] And indeed, there is mounting evidence that SARS-CoV-2 is a laboratory-generated virus,[24] and even the result of potentially illegal[25] bioweapons research.[26]

Novel mRNA- or DNA-based vaccines[27] against Covid-19 have been hailed as a 'remarkable initiative and breakthrough'[28] in science, as 'phenomenal' and 'potentially game-changing'[29] and as 'one of the greatest achievements of mankind',[30] capable of ridding the world of the respiratory SARS-CoV-2 virus in a PHEIC. They have been developed in record speed,[31] funded by governments around the world, based on several new technologies never approved for the use in vaccines before.[32] Despite the limited data available from phase I and II clinical trials (with data from phase III clinical trials now never to be completed[33]), and no safety and efficacy data from controlled long-term human and post-marketing pharmacovigilance studies, both the EMA and the WHO granted various investigational mRNA-based vaccines conditional marketing authorisation,[34] or an emergency use listing (EUL)[35] respectively already in late 2020 and early 2021. Whilst full authorisation by EMA followed in October 2022 for the *BioNTech/Pfizer* and *Moderna* vaccines,[36] WHO currently has 15 investigational vaccines against Covid-19 on its emergency use list.[37] None of WHO's EUL vaccines are fully licensed medical products,[38] and are therefore referred to in technical WHO documents as 'investigational' (i.e. experimental).[39] Their use is justified by the WHO during PHEICs declared by the WHO Director-General on the assumption that 'the community/public health authorities may be willing to tolerate *less certainty* about the efficacy and safety of products, given the morbidity and/or mortality of the disease and the lack or paucity of treatment, diagnosis/detection or prevention options.'[40]

Once the vaccines obtained an WHO EUL, they were (and still are) promoted, distributed and administered worldwide by WHO and its public-private partners, especially through *Gavi* and *Covax*.[41] Their administration has also been promoted through mass vaccination campaigns by WHO member states and the EU. The WHO's Covid-19 Emergency Committee has issued regular benchmarks for the percentage of each country's population that is to be vaccinated by a particular date,[42] and has, in concert with member states and corporate and religious actors, recommended and implemented various measures to encourage, nudge and coerce as many people as possible into taking the investigational products,[43] justified by the assumption that this is necessary and proportionate in order to address the Covid-19-PHEIC. Alternative effective early treatment protocols relying primarily on re-purposed drugs developed at local level all around the world,[44] including by community doctors, have not only not been promoted by the WHO,[45] but arguably actively suppressed.[46]

Moreover, via its so-called 'infodemic management' programme,[47] the WHO in cooperation with its member states, the UN, EU, big technology companies, major news agencies and media corporations have 'pre-bunked', 'de-bunked' and censored numerous contributions questioning among other things the official line of 'safe and effective' vaccines, the strategy to vaccinate the entire world's population with an investigational gene-based product, the viability of the clinical trials conducted in particular by *BioNTech/Pfizer* and *Moderna*, any discussion about early treatment protocols that have proven effective, as well as the solidifying evidence of SARS-CoV-2 as an engineered virus originating from GoF-research.[48] The WHO announces on its website that it, together with *Youtube*, has deleted 850,000 videos between February 2020 and January 2021 alone containing 'medical mis- or disinformation' criticising or questioning 'correct' medical or scientific information as defined by the WHO and the experts constituting many of the WHO's advisory committees.[49]

Emerging evidence, however, gives rise to serious and well-founded doubts about the effectiveness and safety of the investigational vaccines, suggesting that the new mRNA/DNA technology on which they are based carry a high degree of risk of severe harm for individuals. Concerning effectiveness, even WHO recognised now that the vaccines do not block transmission;[50] that the manufacturers' claims on 95% effectiveness of the vaccines in late 2020 always referred to *relative* effectiveness as opposed to *absolute* effectiveness with the latter being on average about 1% for the EUL vaccines available so far;[51] and that clinical trials conducted by manufacturers show serious deficits.[52] Concerning safety, early warning systems recording reports on short-term adverse drug reactions show a worryingly high number of reports on the investigational Covid-19 vaccines. As of July 2023, 35,596 deaths have been reported to the US *Vaccine Adverse Event Reporting System (VAERS)*;[53] 28,299 deaths to EMA's *EudraVigilance* database;[54] and 28,854 deaths in the WHO's own Global Individual Case Safety Reports database, *VigiAccess*.[55] These numbers by far exceed the number of reports on deaths occurring after the administration of conventional vaccines.[56] The number of reports on diverse non-fatal adverse effects is also very high in all three databases,[57] confirmed by a recent re-evaluation of *BioNTech/Pfizer's* and *Moderna's* original trial data.[58] These include serious adverse effects such as myocarditis/pericarditis, thrombocytopenia, anaphylactic shocks, autoimmune disorders and nervous system disorders.[59]

To summarise: the example of the release of the in all likelihood engineered SARS-CoV-2 virus, the continued global administration of investigational Covid-19 vaccines despite the safety signals summarised above, as well as the suppression of effective early treatment protocols illustrate the dysfunction of the current institutional framework set up to implement anticipation duties under the HRS in both the health and (bio-)security context. Even if one accepts that Covid-19 indeed amounted to a PHEIC lasting more than three years despite the low IFR and highly age-stratified disease pattern, this has allegedly led to violations of the HRS (potentially amounting to undue negligence), and with it also to violations of other human rights including the rights to health, life, privacy, freedom of expression and to receive and impart information and freedom of movement. If plans will materialise to build up institutional capacities for comprehensive global biomedical surveillance, to conduct renewed rapid global vaccination campaigns with investigational products[60] and making freedom of movement within states and across borders conditional upon the possession of digital health passports[61] to allegedly ensure GHS, these violations are likely to be repeated.[62] Moreover, if dangerous GoF-research, conducted likely in violation of the 1972 UN Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (BWC), is not thoroughly investigated and terminated globally, and this termination supervised through a publicly funded international institution, the possibility is high of new pandemics occurring, either through the intentional or unintentional release of engineered viruses or other modified biological agents.

An attempt is therefore made to arrive at a better understanding of how anticipation duties under the HRS should be effectively implemented through reformed public domestic and international institutions. As a first step, the notion of 'science' as a communal endeavour or practice underlying the HRS as well as the three-pronged scope of the HRS are examined.

3. The three-pronged scope of the HRS and science as a communal (public) good

The CESCR,[63] scholars[64] and international documents[65] interpreting the HRS protected by Art.15(1)(b) ICESCR and Art.27 UDHR point to three components of this right: first, the right to freely participate in scientific processes and their organisation; second, the right to share and access, and to enjoy the benefits of scientific progress and its applications;[66] and third the right to be protected against the harm of science and its applications. Paragraphs (3) and (4) of Art.15 ICESCR recognise additional crucial elements of the HRS: freedom of science[67] and the need to nurture 'international contacts and co-operation in the scientific […] field'.[68]

What is core to this understanding of the HRS' scope is the *communal* element of science and scientific processes in which 'everyone' has the *equal* individual right to participate[69] and thereby to collectively shape, organise and limit it, and to both share in the benefits and applications of science and scientific processes and, at the same time, be protected against the harm thereof.[70] In parallel, scientific freedom shall be upheld, benefitting everyone engaging directly with science and in scientific processes, including professional scientists and citizen scientists.[71] This is not a contradiction, but points to

the fact that this freedom is essential to enable science as a participative and communal, but open-ended sceptical process of (objective) studying and knowledge seeking in the first place,[72] encompassing both natural sciences and social sciences and humanities.[73] It thrives on transparency, openness, constant questioning, reasoning, critical inquiry and evidence-based challenging of established 'truths'.[74] As confirmed by Art.15(1)(b) ICESCR and Art.27 UDHR, neither of which establishes that science should serve a particular purpose,[75] science and scientific processes and practice are in the first place disinterested and open-ended, that is, results-open. Drafters of both instruments rejected proposals to include a passage that science should serve a particular purpose[76] as they felt that this would open the doors for instrumentalisation, e.g. placing science at the service of ideologies, politics or technocratic social engineering projects, giving states undue levels of control over scientific research and creative activity.[77] As highlighted by Beiter, this fits well with the fact that open-ended and unbiased scientific inquiry is by definition 'unmanageable', precisely because it is open to all sorts of (objective) results in its quest to generate original knowledge.[78]

Respecting and nurturing scientific freedom, scientific inquiry and result-open science will moreover enable sincere, unbiased scientific explorations through which a maximum of knowledge[79] is discovered, which, in turn, will enable enjoyment of the two other components of the HRS – the right to enjoy the benefits of science and the right to be protected from its harm. Maximum knowledge generation through communal participative scientific processes respecting scientific freedom may a) yield scientific practice, 'progress', applications and technologies that can indeed constitute a *benefit* to societies; and b) they may at the same time yield knowledge of and openness about (risks of) *harm* of science, scientific processes and their results.

This further indicates that science and participative scientific processes protected by the HRS should not be instrumentalised for purely economic purposes, and that these processes or parts thereof, or their results and applications should not be privatised for commercial purposes, or otherwise withdrawn from equal accessibility and democratic control.[80] This is in line with Lea Shaver's apt observation that under the HRS, science – the process, its results and applications – should be understood and governed 'as a global public good, rather than as private property'.[81] This re-emphasises the understanding of science as a communal enterprise.

This does not imply, of course, that the HRS prohibits employing scientific processes purely for private commercial purposes. Whilst there is no human right to participate in such scientific processes solely for private commercial gains as this type of science/scientific research cannot be categorised as open-ended, results-open and communal, both the right to share in the benefits and applications[82] and the right to be protected from adverse effects extends to benefits and applications as well as harm from science and scientific processes conducted for either private commercial or military/security-related or any other purpose.

The notion of open-ended science, scientific freedom and science as a communal endeavour underlying the HRS does also not suggest that the scientific processes protected by the HRS cannot be shaped, directed and limited at all in 'democratic societies' or that freedom of scientific research is absolute.[83] Rather, the three components of the HRS point to the fact that it can be determined collectively – through democratic processes based on political equality – which scientific enquiries should be prioritised and

publicly funded within a specific society (and even globally through cooperation and coordination), as long as results of these open scientific processes are not pre-determined (e.g. by excluding the possibility of unexpected or serendipitous results or failure);[84] and in particular, which 'applications' (e.g. goods, services, processes, techniques, technologies, etc.) resulting from such scientific inquiries are sufficiently 'progressive' to constitute a true 'benefit' to be enjoyed by and distributed to 'everyone'.[85] Moreover, understanding science as a participatory and communal endeavour and practice indicates that also decisions about what severity of potential harm and degree of risk of science and technology are acceptable,[86] how they are to be prevented and monitored, and how they are to be balanced against the potential benefits arising from science and technology in a particular context, should be taken through democratic processes.[87] Thus, democratic processes can shape, direct and limit scientific inquiries in light of collective preferences, cultures and local (or even global) challenges and threats, and allocate public resources accordingly.[88] This is affirmed by IHRL's grounding in the mutuality of equality, human rights and democracy,[89] which is clear from equality and non-discrimination provisions[90] as well as political participation rights[91] and numerous references to 'democratic societies'.[92] It also seems to be in this sense that the CESCR in General Comment 25 suggests that science ought to serve human rights and peace (presumably by promoting its benefits and protecting against harm) as a priority over all other uses;[93] but at the same time places great emphasis on the need to secure freedom of science and cherish disinterested, open-ended scientific inquiries.[94]

4. Anticipation duties and responsibilities flowing from the HRS

This brings the discussion neatly to the question about the content and scope of states' anticipation duties flowing from the HRS (4.1); and the content and scope of anticipation responsibilities for the HRS addressing international organisations and other non-state entities, as well as third states that do not exercise jurisdiction (4.2).[95]

4.1. Dual duties to anticipate diligently the (risk of) harm and (opportunities for) benefits of science

Among the important duties addressing states as duty-bearers[96] under the HRS are the dual duties to anticipate both the (risks of) harm and, at the same time, the (opportunities for) benefits of science, scientific processes and resulting applications.[97] More concretely, these are duties to identify and protect against (risk of) harm on the one hand, and duties to identify and promote (opportunities for) benefits of science on the other hand,[98] with due diligence as the required standard of conduct.[99] Other duties flowing from the HRS will ensure that states have the capacities to anticipate both (risks of) harm and (opportunities for) benefits of science and to consequently diligently prevent, avoid or mitigate the former and promote the latter. Among these other duties are duties to respect, protect and fulfil scientific freedom and to receive and impart scientific information, to ensure informed consent, and the overarching duty to ensure democratic (public) control over the scientific enterprise, including the specification of anticipation duties in context.

a) Duties to identify and protect against (risks of) harm of science and its applications

The first part of the dual anticipation duty flowing from the HRS is the duty to identify and to protect[100] diligently against (risks of) harm of science and/or emerging technologies and scientific innovations. As in other areas of international human rights law, such (mostly positive) duties under the HRS arise in particular when the risks of harm have reached a minimal threshold,[101] i.e. when they are risks of 'real' and 'immediate' harm,[102] implying also that they are foreseeable,[103] that is, state duty-bearer knew or should to have known[104] about them.[105] Risks of real and immediate harm from science or its applications that require due diligence conduct[106] from duty-bearers can vary widely and can arise for instance at the level of the individual, at the level of domestic communities or global society and even at the level of the humanity itself[107] (in particular risks of real and immediate harm that may primarily result in violations of the (participatory and communal) core content of the HRS but also, at the same time, the core content of other human rights).

The more specific measures duty-bearers shall diligently take to protect against such risks of real and immediate harm are highly context-dependent, but involving necessity and proportionality analyses.[108] If, for instance, the severity of real and immediate harm and/or the degree of risk of such harm are very high,[109] strict legislative, monitoring, information and enforcement measures may be required right up to prohibitions to carry out certain research and/or to share and distribute certain research results or technologies. This is the case for example in the area of chemical and bioweapons research,[110] concerning the ban on (heritable) human genome editing,[111] and concerning the prohibition to coerce individuals into taking part in medical or scientific experiments.[112] If the real and immediate harm is less severe and/or the degree of risk thereof is lower, mitigation or avoidance duties to diligently enact legislation, to conduct impact assessments,[113] to monitor, to provide information to the public,[114] to conduct ethics reviews,[115] take required budgetary measures,[116] etc. still arise, but they may be less stringent. An example would be the area of medical research with an entire body of medical law regulating *inter alia* the conduct of medical trials and the manufacturing of medical products to ensure that only medical products and innovations are distributed that are safe (and effective) in addressing one or more precise conditions, and where adverse effects (or risks thereof) have been sufficiently well delineated to conclude that they are tolerable and manageable in individual cases.[117]

The more concrete scope of anticipation duties (and their stringency) to diligently address real and immediate harm from science may also be influenced by further considerations, such as the extent to which states have the capacity to address that harm. It might be, for instance, that the sources of harm of science and its applications are located outside the respective state's territory of jurisdiction or that they are exclusively under the control of influential private entities. In such cases, duties to cooperate and to coordinate internationally (including the co-specification of prevention and precaution duties among states[118]) may become particularly important.[119] And, as discussed further in section 4.1.e) below, under the HRS it should not only be determined scientifically, i.e. based on the current state of scientific knowledge or what is deemed to be a 'scientific consensus', what the risks of real and immediate harm from science are that should be diligently prevented or mitigated, but other considerations may play a role

in the normative reasoning of a self-determined 'democratic society' about such questions.[120]

Whilst many anticipatory duties to protect against real and immediate harm are positive duties to with due diligence 'protect' against harm emanating from scientific activities and their applications of third parties and positive duties to 'fulfil', negative duties to 'respect' can also arise. Among them are for example duties not to allocate public funding to scientific research that risks causing real and immediate harm, not to manipulate or suppress reports and data on harmful effects of science and its applications,[121] not to undermine effective international cooperation for the control of risks of real and immediate harm from science and its applications,[122] and duties to refrain from using harmful technologies and/or making them available to third parties. An example here might be duties to refrain from using certain networked digital surveillance technologies which may undermine science as a communal, participative process as protected by the HRS and, in addition, may 'in manifold ways […] threaten human rights and the rule of law [more broadly] and may erode vibrant, pluralistic democracies'.[123] The Office of the UN High Commissioner on Human Rights (OHCHR) has described this threat as 'profoundly alarming'.[124] Moreover, duties to remedy arise.[125]

b) Duties to identify and promote (opportunities for) benefits of science

The second part of the dual anticipation duty flowing from the HRS is the duty to identify and promote[126] the benefits and opportunities for benefits of science and its applications. Though not expressed in such terms by the CESCR in its General Comment 25, in parallel to the risks of harm discussed above, the opportunities for benefits of science, scientific knowledge and its applications that states as duty-bearers shall promote shall arguably be opportunities for real and immediate benefits,[127] i.e. they shall indeed constitute 'progress of science and its application', where science is understood as the communal and participatory endeavour described in section 3. In addition, (opportunities for) benefits must arguably be foreseeable, i.e. states knew or should have known about them for duties to diligently promote them to arise.

More concretely, and in accordance with Art.15(2) ICESCR, states shall develop, conserve and diffuse (potentially) beneficial scientific knowledge and ensure broad access to and availability of (potentially) beneficial applications of science and technologies.[128] The exact scope and content of the diligent legislative, administrative, (public) budgetary and other measures to be taken towards the promotion of the opportunities for real and immediate benefits of science and its applications will once more depend on context,[129] *inter alia* on the size of the (opportunities for) benefit,[130] the degree of certainty with which it may materialise and the capacities of the respective state, including its financial means[131] and its ability to overcome existing obstacles to ensuring access, availability and diffusion.[132] Once more, these obstacles or threats may be located outside the jurisdiction of the duty-bearing state, or be due to the control private entities have over the benefits of science and its application in question. Of course, also in regard to the promotion of benefits of science and its applications both positive duties to 'protect' and to 'fulfil' arise, including remedial duties,[133] as well as negative duties to 'respect'.

c) Duties to respect, protect and fulfil scientific freedom and to receive and impart scientific information

Though not immediately obvious, upholding scientific freedom and the conduct of results-open, participatory scientific processes are important duties that will allow states to also implement their anticipation duties discussed above. Protecting scientific freedom would include a duty not to interfere with, and pro-actively protect and fulfil, the choices and priorities set by scientists themselves,[134] as well as their freedom to collaborate with one another (including across borders)[135] and their freedom of expression and the freedom to seek, receive and impart scientific information,[136] including through publishing the results of their research;[137] and to ensure that all persons and public and private entities do so.[138] This would also entail a duty to secure the institutional autonomy and self-governance of universities[139] and other public research institutes, as well as their financial independence.[140] The latter requires states to ensure that public funding or funding provided by private entities for collective scientific research processes protected by the HRS is unconditional in the sense that it respects the openness and freedom of science and the unpredictability of its outcomes. Thus, such funding not unduly restrict or determine the (commercially, militarily, ideologically or otherwise desired) outcome of the research activities undertaken by professional or citizen scientists, and the evaluation of the risks and harm connected with specific scientific research and its outcomes as well as its potential benefits.[141] Complying with these duties will ensure rigour as well as transparency and openness of scientific processes which, in and of itself, will contribute to revealing, understanding and monitoring risks of harm and opportunities for benefits of science, technology and/or the products and applications they yield.[142] This in turn will make these risks and benefits 'foreseeable' for states, enabling them protect against harm and promote benefits.

d) Duties to ensure free and informed consent

The stringent[143] duty on states to ensure that all persons and public or private entities that conduct scientific or medical research involving human participants obtain free, prior and informed consent,[144] and that participants are aware of their right not to participate in medical or scientific experiments[145] and their right to withdraw their consent at any time[146] is another state duty flowing *inter alia* from the HRS. This duty is reinforced by Article 7 ICCPR, the prohibition of torture or inhuman or degrading treatment, which directly establishes that 'no one shall be subjected without his free consent to medical or scientific experimentation'.[147]

Obtaining free, prior and informed consent explicitly requires that scientists and medical researchers continuously inform participants of scientific or medical experiments in an understandable way about all known and unknown evolving short-term and long-term harm and risk thereof that participation implicates.[148] At least for research involving human participants, this will require that scientists thoroughly evaluate and monitor the harm and risks associated with their research and the applications it produces, and that they communicate them openly. Moreover, ensuring free and informed consent means that neither direct coercion, nor indirect coercion, nor

any other form of undue pressure or incentives can be relied on to coerce, pressurise or entice individuals' participation in medical or scientific experiments or clinical trials.[149] This will also further transparency and openness on known and unknown harms and risks involved, and help to prevent instrumentalisation of scientific research.

For scientific research not involving human participants other independent mechanisms, from ethical approval processes to continuous monitoring and reporting,[150] can ensure that scientists and researchers are required to constantly observe, record and communicate the short- and long-term harmful effects (or risks thereof) that their research and outputs may have on science as a communal and participative enterprise, as well as humans, animals and the natural world.

e) Duties to ensure democratic participation in the assessment of (risks of) harm and (opportunities for) benefits of science

One aspect of the overarching duty under the HRS to ensure the democratic control over the communal scientific enterprise as a whole[151] is the duty to specify in context, through a democratic process, the thresholds of risks of harm of science and its applications that a particular 'democratic society' may tolerate, as well as the priorities for the promotion of (potentially) beneficial scientific research and knowledge and applications of science. It is clear that the materialisation of risks of real and immediate harm emanating from science and its applications that interfere with the inherent minimum core content of the HRS or other human rights shall be diligently prevented, avoided or mitigated as part of states' anticipation duties under the HRS. The assessment and evaluation of other harms and risks thereof can, however, vary in accordance with cultural, ethical, religious, social, financial and other factors and preferences, in particular when uncertainties are involved, or the matter is a matter of pervasive reasonable disagreement within a democratic society. The same is true for the assessment and evaluation of (opportunities for) benefits of science and its application. Moreover, there can be cases in which a fair balance must be struck between duties to prevent risks of harm on the one hand and duties to promote benefits on the other hand, in particular when the risks and benefits emanate from so-called dual-use scientific research, scientific innovations or technologies. The numerous references to 'participation'/'participatory processes'[152] and even 'democracy'/'democratic debate'/'democratic society'[153] in the CESCR's General Comment 25 indicate, that in such cases, states are duty-bound to ensure that decisions are taken via an open, informed, democratic debate, respecting everyone's equal HRS, resulting in the adoption of relevant domestic laws capturing the contextualised results. Participation and democratic processes will furthermore address secrecy and collusion that threaten the integrity of science and thus promote transparency,[154] including in regard to its benefits and harm. The CESCR observes in this context:

> '… in controversial cases, participation and transparency become crucial because the risks and potential of some technical advances or some scientific research should be made public in order to enable society, through informed, transparent and participatory public deliberation, to decide whether or not the risks are acceptable.'[155]

f) Duties to cooperate and coordinate internationally

Duties to cooperate flow from the HRS, supported also by Arts.2(1) and 15(4) ICESCR. Such cooperation and coordination is necessary in particular when harms (or risks thereof) emanating from science and technology are cross-border harms or risks, and diligently protecting individuals from them requires cooperation and coordination with other states,[156] and even the domestic co-specification of anticipation duties among states and their coordinated implementation.[157] The latter is the case for example when a specific (real and immediate) risk of harm of science – e.g. the conduct of GoF research – can only be prevented when all states *together* secure the prohibition of such research as the expression to prevent the specific, and in this case global, harm of GoF-research and science. This requires that states co-specify their domestic prevention duties. Similar cooperation and coordination duties arise in relation to the promotion of (opportunities for) benefits of science and its application, access to which can often indeed only be secured through international cooperation and coordination.

Cross-border scientific engagement and debates will also enable researchers and scientists to openly share their concerns on harms and risks of harm of certain scientific and technological research, developments, innovations and their applications, as well as their expectations of potential benefits. This, in turn, can enable low-income states with limited capacities and resources to react to such concerns even if their scientists may lack access to relevant information, certain expertise and/or resources, and adopt measures to enable the enjoyment of benefits.[158]

International cooperation and coordination duties among states will also arise in relation to third entities like multinational corporations whose primary concern is to maximise profits for their shareholders from the scientific research they employ towards this end, and not to secure science as a (communal) public good whose benefits are promoted and shared and whose risks of harm are prevented and controlled for everyone equally.[159] States' cooperation and coordination duties to 'protect' should thus ensure that the scientific activities of multinational corporations do not cause harm, and that benefits are made widely accessible. For example, this would imply that states shall cooperate and coordinate in order to ensure that legal protection of informed consent of participants in medical or scientific research is upheld and enforced together in all countries to prevent pharmaceutical companies from carrying out clinical trials in low-income countries due to lower costs and low levels of domestic legal protection of informed consent, to the detriment of the communal and participatory scientific enterprise as a whole and of the people living in low-income countries, undermining these people's HRS.[160]

Last but not least, states must uphold their duties under the HRS as members of international organisations, and make sure that decisions taken, and policies adopted by these organisations do not undermine their ability to secure the HRS within their territory, including their anticipation duties. If competences are transferred to international organisations, states must ensure that human rights protection provided by the organisation is equivalent to that required of the states' duties.[161]

4.2. Responsibilities to anticipate diligently (risks of) harm and (opportunities for) benefits of science

Entities other than states of jurisdiction have anticipation responsibilities[162] for the HRS. Their overarching aim, which, in turn, determines their scope, is not to undermine but to enable and assist states of jurisdiction to discharge their anticipation duties under the HRS that these states owe to the people under their jurisdiction.[163] Their scope is thus regularly determined in relation to states' jurisdiction-based anticipation duties.[164] Though not elaborated on directly in General Comment 25,[165] many other General Comments of the CESCR identify international organisations like the WHO[166] and other UN organisations and specialised agencies[167] and the EU,[168] but also private actors like business enterprises,[169] NGOs,[170] research institutions,[171] among the bearers of responsibilities for human rights. Moreover, states that do not exercise jurisdiction have responsibilities for human rights in all other states.

Responsibilities are not owed to concrete individuals but to states and their (democratic) institutions. The CESCR has for example highlighted that international organisations should cooperate effectively 'in relation to the implementation of [human …] right [s …] at the domestic level',[172] i.e. in supporting states in their efforts to discharge their human rights obligations. The same can be inferred from statements concerning responsibilities of other non-state entities owed to states,[173] as highlighted in particular in the 1999 UN 'Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms'.[174] This Declaration points to non-state entities' 'responsibility in … promoting human rights … and contributing to the promotion and advancement of democratic societies, institutions and processes',[175] where the latter are required for states to be able to implement their human rights obligations – including their anticipation duties under the HRS – in the first place.

Since responsibilities for human rights do not depend on the exercise of (human rights) jurisdiction, grounds for allocating them to specific bearers must be identified. Among them are capacity (which can include expertise, knowledge and power[176]), outcome, causality, harm, benefit or special ties.[177] When it comes to anticipation responsibilities under the HRS, international organisations engaged in science, epistemic communities actively involved in scientific processes (including those institutionalised in universities or other research organisations) and corporations relying on scientific research are among the prominent responsibility-bearers.

The CESCR remains largely silent about the legal basis for responsibilities for human rights in general and for anticipation responsibilities for the HRS in particular. Art.2(1) ICESCR can be identified as the legal basis for responsibilities for human rights of states that do not exercise jurisdiction,[178] and Art.15(4) ICESCR for their anticipation responsibilities for the HRS. For international organisations, such responsibilities can derive from their constitutive instruments or international agreements to which they are parties as well as customary IHRL.[179] When it comes to the WHO, for instance, both the references to human rights and in particular the right to health in its Constitution[180] and references to human rights in the IHR[181] can be seen as legal bases for responsibilities for the human right to health and the HRS, as can emerging customary IHRL addressing international organisations.[182] The latter may also address other non-state

responsibility-bearers,[183] though open questions remain as to what counts as state practice and *opinio iuris* in this context which cannot be examined here further. In addition, (mostly non-binding) declarations exist which specify responsibilities for different human rights addressing various state[184] and non-state[185] actors in different contexts. The legal weight/degree of normativity of various responsibilities for human rights, including anticipatory responsibilities for the HRS, can vary, depending also on the extent to which they have been concretised and are thus sufficiently precise and foreseeable for respective responsibility-bearers. There is, however, no tailored institutional framework as of yet through which anticipatory responsibilities for the HRS might be specified and allocated to the various responsibility-bearers, especially no international institutional framework.[186]

5. Sketching the public institutional framework

The discussion now moves to the institutional questions: What domestic and international institutions[187] are states parties to the ICESCR obliged to set up so that they can identify, specify and discharge their anticipation duties under the HRS? The example of the in all likelihood engineered SARS-CoV-2 virus and the global response to develop, distribute and administer investigational vaccines based on a new technology to the world's population to stop its spread, as well as the parallel suppression of effective early treatment protocols is returned to with the aim to highlight the features that this institutional framework should possibly have with the help of this concrete example.

5.1. The domestic public institutional framework

In general, human rights treaties envisage domestic democratic or democratising public institutions for the implementation of states' human rights duties, including the anticipatory duties flowing from the HRS. For example, the CESCR has confirmed that the ICESCR 'neither requires nor precludes any particular form of government or economic system being used as the vehicle for the steps [to be taken to implement socio-economic rights] … , provided only that it is democratic,'[188] whilst the ECtHR has long held that 'democracy is the only political model contemplated by the [European] Convention [on Human Rights] and, accordingly, the only one compatible with it.'[189] They have further specified that this implies the existence of a comprehensive unitary institutional framework consisting of an elected legislature[190] and an independent judiciary,[191] and that democratic institutional systems are further incorporating various principles, such as the separation of powers,[192] free elections,[193] political pluralism[194] and judicial review.[195] This also points to the fact that institutions securing human rights shall be *public* institutions that allow for the identification and specification of human rights duties within the domestic context through democratic contestation and judicial review, respecting political equality and the inherent cores of the human rights of all members of 'democratic societies', and securing and controlling funding for the implementation and enforcement of these duties.[196] Private entities should be separated from and controlled by public institutions exercising democratically-controlled public authority. Through internal allocation in domestic (criminal or private) law adopted by public democratic institutions, private entities can have derived obligations to

contribute to the implementation of the HRS and other human rights (e.g. by paying taxes or providing access to scientific knowledge) and to refrain from interfering with their enjoyment. In addition, states may need to set up specialised public institutions – for example an ethics council,[197] research funding institutions,[198] universities,[199] a medical agency, etc. – to implement the HRS in particular.

a) Domestic legislative institutions

Legislative domestic institutions shall adopt relevant domestic law conforming to the human rights legality[200] standard in terms of quality and democratic origin in order to specify, internally allocate and implement the various anticipation duties under the HRS discussed above. In relation to the appearance of SARS-CoV-2 and subsequent laws and policies involving the development and promotion of some scientific research and new technologies whilst supressing others several questions would arise. In particular: whether domestic legislatures of states that ratified the ICESCR have, through a thoroughgoing, transparent and open deliberative debate[201] assessed both the risks of real and immediate harm and opportunities for real and immediate benefits of GoF-research with SARS-CoV viruses, the strong promotion of research, development and large scale administration of investigational vaccines based on novel mRNA/DNA technologies and the suppression of early treatment protocols for Covid-19 developed by community doctors around the world, and adopted relevant legislation to promote real and immediate benefits and prevent real and immediate harm.

Concerning GoF research with SARS-CoV, a strict legal prohibition would be in line with a good faith interpretation of Art.1 of the 1972 BWC.[202] Given the harm that was caused by the likely release of the engineered SARS-CoV-2 virus from a research laboratory, it is clear that this harm is real and immediate; and that the harm from another laboratory-generated virus resulting from GoF-research can be immense and the risk of such harm occurring high, justifying a strict prohibition of GoF-research with viruses in domestic law. Moreover, given the *global* harm from GoF-research, collective duties on states arise to globally coordinate and co-specify such a prohibition and its implementation and enforcement.[203] Coordination could happen *inter alia* by strengthening and possibly reforming international institutions like the Implementation Support Unit for the BWC, operating within the UN Office for Disarmament Affairs;[204] and ensuring that coordination and co-specification encompasses states' anticipation duties to protect, i.e. duties that make sure that military and security actors, including private military and security companies, do not engage in risky and harmful GoF-research.

Concerning the legal and political suppression of early treatment protocols with repurposed drugs in many countries, even though these repurposed drugs appear safe and effective against the Covid-19 illness[205] and thus involve very limited and well delineated adverse effects that are manageable in individual cases,[206] questions arise as to why they allegedly have nonetheless been assessed as too risky, and why benefits have not been recognised and promoted by domestic law and policy. The latter included in many countries the suppression of the sharing of relevant scientific and medical knowledge generated by doctors working at local level all around the world.

Concerning the promotion of investigational vaccines, in line with the CESCR's proposal on how to proceed in 'controversial cases' characterised by high degrees of

uncertainty and disagreement, though unlikely, it is not *a priori* excluded that despite the low average IFR of Covid-19 and the fact that effective and safe early treatment through repurposed drugs is available, legislation is adopted enabling first of all public investment into the development of vaccines based on novel mRNA/DNA technology. And second, legislation permitting the subsequent distribution and administration of investigational vaccines might be embraced. Such decisions would reflect the possible willingness of a (democratic) majority to accept both the associated potential severe harm and a high degree of risks of such harm associated with the mass administration of such investigational medicinal products in a situation of an alleged health emergency. However, decisions must indeed be taken a) as a result of an 'informed, transparent and participatory public deliberation'[207] involving and taking account of both everyone's equal HRS and other human rights. Moreover, if b) the risks of real and immediate harm are recognised the due diligence standard of conduct would require that further safeguards are legislated for to monitor the risks of real and immediate harm, inform about, and clearly limit and, as far as possible, prevent them.[208] Existing legislation already safeguarding against (risks of) harm of newly developed medicinal products would need to be very carefully applied to the distribution and administration of the investigational Covid-19 vaccines, in particular when clinical trials have not been finished due to an alleged health emergency.

In regard to a) the democratic decision-making process would require full transparency and a thorough examination and discussion of all available data, information and knowledge, including those held by universities, domestic medical agencies or public health institutes, private actors like pharmaceutical companies,[209] PPPs and international organisations like the WHO and the EU, and in particular their relevant specialised technical committees. Among them are for example the WHO's technical Advisory Committee for Emergency Use Listing (TAG-EUL) making the decisions to grant EULs,[210] and EMA's Committee for Medicinal Products for Human Use (CHMP) making scientific recommendations to grant conditional and full marketing authorisations.[211] Similarly, recommendations coming from these organisations or specialised domestic institutions, e.g. WHO recommendations to vaccinate a certain percentage of the population by a specific date,[212] should be discussed, legislated for and implemented in light of local preferences concerning the severity of harm and degree of risk of such harm occurring that a specific 'democratic society' is willing to accept; and recommendations violating IHRL, in particular the inherent core of the HRS or of other human rights, should not be implemented. Among such recommendations would for example be recommendations to supress, 'pre- and de-bunk' or censor alleged medical 'mis- or disinformation' as defined by the WHO,[213] stifling results-open scientific (and medical) debate, including about risks of real and immediate harm; coercing, enticing or otherwise pressurising individuals into taking investigational EUL vaccines in violation of informed consent, the HRS and other human rights; or following WHO's recommendation to advertise the products as 'safe and effective' when the full clinical trials can no longer be finished, and clear safety signals are present.[214] Open and fully transparent parliamentary debates must, of course, also take account of considerations other than the data derived from limited clinical trials, such as financial, economic, cultural, religious, ethical or social considerations, and the general disease burden within a society. This guards against the danger that (risks of) harm and (opportunities for) benefits of science and

the ways to diligently address the harms and promote the benefits are exclusively evaluated scientifically by scientists (or 'experts') themselves – a danger that should be guarded against to prevent the further 'technocratisation' of decision-making processes that may lead to one-sided decisions and replace other modes of (normative) reason giving.[215]

Regarding b) (and related to a)), in line with state anticipation duties outlined above, scientific freedom to investigate and research alternatives to mRNA/DNA-based vaccines should be upheld by law and in practice, as should freedom of expression and the right to receive and impart scientific information on the mRNA/DNA-based vaccines and any other research activities. This would entail also general legislation requiring public and private entities conducting scientific or medical research to publish the results of clinical trials, including all details on negative outcomes; and to ensure that these results are not manipulated. Such practices by e.g. pharmaceutical corporations undermine both the general openness of science as a participatory process and the ability to evaluate and understand harm and risks of harm connected to various scientific or medical research and its outcomes.[216] Openness and publication should be the norm, even if the research is conducted for profit and thus commercial secrets may be involved; or even if the research is conducted in the context of a health emergency. Moreover, the stringent protection of prior free and informed consent of participants in scientific or medical research as well as of other routine ethics approval procedures for scientific research projects must be upheld by law to prevent real and immediate harm to individuals. Legislation would need to ensure that careful monitoring of known and unknown short- and long-term harm and risks associated with the administration of a novel investigational medical product is conducted by a specialised domestic agency, e.g. a medical regulator. Last but not least, to effectively protect against harm, states would need to coordinate the implementation and enforcement of the mentioned duties to ensure the enjoyment of science as a communal (public) good.

b) Specialised domestic institutions

Specialised domestic institutions are required to enable states to implement their anticipation duties under the HRS too. They should be set up through legislation adopted by a legislature, but their further self-regulation on the conduct of science as a participative and communal endeavour should be encouraged, including around the anticipation of the (risks of) harm of the scientific research they are engaged in and the prevention or mitigation of such (risks of) harm. Independence and self-regulation of specialised institutions will contribute to upholding scientific freedom, and promote transparency, enabling such agencies and institutions to also inform above-mentioned thorough, open, deliberative debates through (democratic) public institutions – be they parliaments, courts or executive institutions – around the (risks of) harm and (opportunities for) benefits of scientific endeavours.

For the context of our example, a medical agency (and/or universities or other research institutions) would need to closely examine and evaluate relevant data from clinical trials held by third parties and potentially conduct their own studies and collect their own data on the safety and effectiveness of new medical products, and *inter alia* inform democratic deliberation processes. They would also need to have a mandate to monitor and investigate adverse effects of newly introduced medical

products, in particular when they are investigational, based on new technologies and authorised on the basis of an emergency procedure, e.g. by setting up a system to this effect, and to define clear thresholds as to when warnings must be issued and/or a novel medical product or technology must be barred from further distribution and administration. There are indications that e.g. the *VEARS* system set up by the US medical regulators CDC and FDA has so far not been used with regard to monitoring of the adverse effects reported in connection with the Covid-19 vaccines.[217] Given the fact that international institutions are involved in the monitoring of adverse effects too, domestic agencies should be empowered to cooperate and coordinate with and through these institutions, including by obliging them to critically evaluate the data collected through their databases like *VigiAccess* at WHO and *EudraVigilance* at EMA. At the same time, a medical agency should also engage with and evaluate data and reports from local doctors developing effective early treatment protocols using re-purposed drugs – as these doctors may also be considered to engage in the open-ended, participatory and communal process of science within their area of (medical) expertise[218] – and promote any less harmful and less risky alternative to the large-scale administration of investigational Covid-19 vaccines.

More generally, domestic medical agencies need to be given all relevant competencies and adequate public funding to independently support the legislature, executive authorities and the judiciary to protect against real and immediate harm (or risks thereof) from investigational Covid-19 vaccines, as well as any other novel medical product developed, distributed and applied to the population. Other special domestic institutions, such as an ethics council or a public research funding agency might also be required to secure the HRS.

c) Judiciary

The domestic institutional framework also importantly comprises an independent judiciary which can offer an effective remedy to those whose HRS has been violated.[219] This includes violations of the right to be protected against the harm caused by investigational Covid-19 vaccines. Though not spelt out explicitly by the CESCR General Comment 25, to ensure that the judiciary can indeed offer an effective remedy for violations, legislative and executive authorities must give the judiciary sufficiently broad competences to review relevant decisions by public authorities, universities, PPPs and private entities, including pharmaceutical corporations, and, as much as possible, by international organisations. All forms of undue obstacles, e.g. in form of broad immunities, strong protection of commercial secrets and interests that undermine access to relevant information, limitations to hearing independent expert witnesses on scientific evidence as well as on other relevant financial, economic, cultural, religious, ethical or social considerations, etc., or problems of non-compliance with judgments, must be removed so that individuals can indeed enjoy effective judicial remedies for violations of the HRS as a matter of fact. This is all the more important because remedies offered at the international level via UN treaty bodies (i.e. the CESCR), remain very limited,[220] in particular when international organisations and multinational corporations are involved, and any decisions remain difficult to enforce.

d) Upholding the public – private divide in the domestic institutional set-up

The institutional set-up sketched out above must be *public* to ensure the protection of science as a communal public good. This becomes particularly important against the background of the current dominance of powerful private actors in the field of science and scientific research amounting to a *de facto* privatisation of most parts of the scientific enterprise, including the scientific enterprise around the investigational Covid-19 vaccines.

States' anticipatory duties under the HRS and broader duties to secure freedom of science and the conduct of disinterested, results-open science implies that the independence of researchers, scientists and science publishers must be secured through legislation and the provision of public funding that is unconditional in that it does not push scientists and researchers towards coming to pre-determined results or focus only on specific topics or research areas. For the same reason, public funding is also required for specialised institutions discussed above, e.g. medical agencies, ethics councils, universities and other research institutions. The dominance of pharmaceutical industry funding[221] and funding provided by philanthropic entities like the BMGF (and its Vaccine Alliance *Gavi*)[222] and the *Wellcome* Trust (which are both highly interconnected with the pharmaceutical industry[223]), in particular in the area of medical research, scientific publishing and even media reporting,[224] should be critically examined in this context, as well as the fact that domestic medical regulators are in large parts funded by the industry and these entities too.[225] In addition, the appearance of more and more PPPs in which the public and the private are blurred,[226] as well as phenomena like excessive lobbying,[227] astroturfing[228] and even regulatory capture[229] of (formally) public legislatures, medical regulators and executive authorities,[230] must be addressed. Arguments made that the increasingly aggressive work of lobbyists and the disproportionate influence of often globally acting profit-seeking corporations or philanthropic organisations is incompatible with the effective protection of the HRS (and human rights in general) including the democratic (public) control of the scientific enterprise should be discussed openly.[231] Such developments are also the result of the general trend of the systematic privatisation of activities traditionally performed by (democratic) state institutions that led to an erosion of public (state) authority.[232]

The blurring of the public and the private is furthermore present in the frequent exchange of personnel between (public) medical agencies, the big philanthropic organisations and the pharmaceutical industry,[233] and the numerous 'independent' experts whose work might be funded by the industry and/or the BMGF and the *Wellcome* Trust. In such cases, requiring mere public declarations of conflicts of interests[234] might not be enough to ensure that specialised medical agencies, universities and research institutions are clearly able to protect against the harm of science and promote its benefits, and to enjoy scientific freedom.

Standards for independence of various specialised domestic institutions informed by the HRS could be developed further by domestic courts and the CESCR through engagement with state parties to the ICESCR, e.g. via the state reporting and individual complaint procedures. IHRL standards developed on judicial independence which ensure independence of courts from both private entities and other state institutions (including financial independence) to make sure that the judiciary acts in the public interest

protecting human rights, equality and democracy,[235] could potentially inspire the developments of such standards.

5.2. The international public institutional framework

States should set up international public institutions in order to coordinate the (internal) specification of their anticipation duties as well as their implementation and enforcement, in particular in cases where, due to the transboundary or global nature of the potential benefits and/or the (risks of) harm of science can be promoted and/or prevented or mitigated indeed only through global co-specification of (internal) state duties and their coordinated implementation.[236] In addition, international cooperation and coordination through international institutions may be required for combining resources, bundling expertise and sharing burdens of implementing states' collective anticipatory duties under the HRS. At the same time, international institutions can become bearers of (anticipatory) responsibilities for the HRS.

As indicated above, given the highly likely laboratory origin of SARS-CoV-2, there should be widespread agreement among democratic (or democratising) states and their domestic legislatures that the severity of potential harm and the degree of risk of harm of GoF-research involving SARS-CoV (and other) viruses are very high. This agreement is expressed in the 1972 BWC, though it should be further strengthened through additional clarification of Art.1(1) BWC.[237] Coordination and co-specification of (internal) state duties could happen *inter alia* through the Implementation Support Unit for the BWC, operating within the UN Office for Disarmament Affairs.[238] Strengthening the Support Unit and possibly transforming it into an organisation with verification and redress capacities modelled on the Organisation for the Prohibition of Chemical Weapons (OPWC), the implementing body of the Chemical Weapons Convention (CWC),[239] could be helpful to secure a prohibition of GoF-research globally. At the same time, anticipatory *responsibilities* for the HRS – in particular for supporting states of jurisdiction in their activities to protect against the harm of GoF-research – would lie with the Support Unit (or a reformed version of it), based on its capacities and in particular its expertise, knowledge and powers. Such anticipatory responsibilities could be specified in a revised BWC.

International cooperation and coordination, including the co-specification of (domestic) anticipation duties and their implementation through international organisations becomes much more difficult when there is no agreement among democratic states as to the potential benefits and (risks of) harm deriving from a particular scientific research project and / or its applications, but if promoting benefits and protecting against (risks of) harm nonetheless requires such cooperation and coordination for these benefits to materialise and (risks of) harm to be prevented or mitigated. This is aggravated in a situation where existing international organisations – for example the WHO concerned with questions of medical science in relation to global health problems – does not 'work along egalitarian lines' and is not 'sufficiently participative'[240] to ensure the equal enjoyment of the HRS of all people and is no longer a *public* international organisation. The example of the WHO's strong promotion of investigational Covid-19 vaccines and the parallel suppression of early treatment protocols are an example of the dysfunction of the current international institutional framework. Nonetheless, due to its mandate, expertise and

power set out in its Constitution,[241] the WHO would have anticipatory responsibilities for the HRS in the area of medical science and research.[242]

In principle, given that WHO lacks the democratic legitimacy of domestic institutions which are (or at least should strive to be) able to carefully balance the preferences of the equal members of a 'democratic society' concerning the harm and risks it is willing to take and make collective decisions accordingly, WHO will need to link back to the decisions made at the domestic level in its member states to guide its own activities. Such might happen to some extent through resolutions adopted by the annual World Health Assembly held in Geneva, resulting from an open and well-informed debate among representatives of all member states.[243] However, decisions concerning PHEICs are taken almost unilaterally[244] by the WHO Director-General, possibly with the involvement of an 'expert' Emergency Committee whose members are appointed by the Director-General from an IHR Expert Roster,[245] based on technical criteria which remain rather vague.[246] Among other, such decisions on the existence of a PHEIC trigger WHO's EUL programme which can lead to the worldwide distribution and administration of unlicensed medical products as medical countermeasures recommended by the WHO to address the PHEIC. The potential harm and benefit of these EUL-products are evaluated by a technical TAG-EUL,[247] and it can be assumed that their risk-benefit assessment is taken based on the perception specified in the WHO's EUL documents that societies will tolerate less certainty about the efficacy and safety of investigational medicinal products during a PHEIC,[248] and thus higher levels of harm or risks thereof. This can raise questions as these WHO decisions may not be in line with WHO's anticipation responsibilities for the HRS (and potentially also for overlapping responsibilities for the right to health and for other human rights) and may contradict the decisions taken through democratic procedures at the domestic level. Concerning the example of investigational Covid-19 vaccines, it might, for example, be that in countries with young populations at very low risk from Covid-19, accepting the high degree of short- and long-term risks of potentially severe harm of rolling out an investigational gene-based vaccine to the entire population outweighs the alleged benefits to allegedly limit the spread of SARS-CoV-2;[249] and allocating significant parts of a domestic health or science budget to the organisation of their roll-out (including via *Covax*) may not correspond to the actual disease burden within a particular country to be addressed as a matter of priority.

Thus, decision-making procedures that work on egalitarian lines for WHO member states and are more participatory and fully transparent, based on the input of myriad domestic institutions would need to be established at WHO. Differentiated approaches as to how the WHO decisions and recommendations are to be implemented in different countries with varying levels as to the (risks of) harm of (medical) science their 'democratic societies' are willing to accept would need to be found. Moreover, as bearers of anticipation responsibilities flowing the HRS, the WHO technical committees set up to issue EULs (TAG-EULs) for unlicenced medical products would need to thoroughly and openly evaluate all safety and efficacy data provided by manufacturers, or, if the accuracy of data submitted cannot be verified, mandate and closely supervise additional clinical trials.[250] Mounting reports on serious deficits of the clinical trials conducted by some of the Covid-19 vaccine manufacturers indicate that both WHO's TAG-EULs and Strategic Advisory

Group of Experts on Immunization (SAGE)[251] may have failed to do so in the process of issuing EULs for the unlicensed products.

Once WHO recommends a certain course of action based on the outcome of a (reformed) decision-making procedure and actively promotes and distributes investigational medical products based on new technologies, monitoring and alerting to harmful adverse effects should arguably also be among WHO's tasks complying with its anticipation responsibilities to mitigate real and immediate harm under the HRS. This should also include removal of EUL products, should it appear that their harm violates the minimum core content of the HRS and/or other overlapping human rights. Through such activities the WHO could indeed enable and support states to coordinate the implementation of their own anticipation duties. States lacking the capacities and resources for setting up sophisticated reporting and evaluation systems for adverse effects of novel WHO-recommended EUL products could indeed rely on such a system run by the WHO (like the *VigiAccess* database), and safety signals detected through domestic or regional systems like the US' *VEARS* or the EMA's *EudraVigilance* could, through cooperation, be amplified, distributed and reacted upon more promptly and effectively. However, even though the WHO announces on its website on Covid-19 vaccine safety that it 'supports work with vaccine manufacturers, health officials in each country and other partners to monitor for any safety concerns on an ongoing basis',[252] it is not clear what safety signals are required before it recommends pausing or stopping the distribution and administration of an EUL product and/or withdraws its EUL – a safety signal on which also the WHO's Global Advisory Committee on Vaccine Safety (GACVS) can act in a foreseeable and reliable fashion. It does not appear that such thresholds have been defined in the WHO's publicly available documents so far,[253] nor is it clear how GACVS utilises the reports in *VigiAccess*. Considering the high numbers of reports on adverse events in *VigiAccess, VEARS* and *EudraVigilance*[254] concerning the investigative Covid-19 vaccines, it appears that thresholds relied on in earlier mass vaccination campaigns are no longer valid. For example, in 1979 a vaccination campaign covering almost 25% of the US population at the time (about 45 million US citizens) against swine flu in the US was discontinued after 25 deaths and 362 serious neurological disorders were reported after vaccination.[255]

The WHO should also assist states in co-specifying and coordinating the implementation of duties relating to the protection and promotion of scientific freedom and open scientific debates in the medical field, and, given its expertise and power, WHO will arguably have a responsibility for the HRS in this area too. As argued above, such debates enable the understanding of potential benefits and harm of (medical) science in the first place, in particular when the development, distribution and administration of novel medical products is involved where the scope of the benefits and the severity of potential harm and degree of risk of harm remain uncertain. The WHO's 'infodemic management' programme appears to contradict its responsibilities for the HRS in this area, undermining states' ability to comply with their anticipation duties. 'Infodemic management' coordinated during the Covid-19 pandemic by the WHO prevented and continues to prevent an open and thorough scientific debate on many aspects of the WHO's and its member states' response to SARS-CoV-2.[256] Alternative WHO mechanisms through which scientists, medical doctors and the interested public could indeed have an open scientific discussion about known and unknown harm (and risks

thereof) of novel medical products and on-going alternative scientific and medical research – digitally or via in person meetings – should be established, replacing the 'infodemic management' programme.

Last but not least, as with domestic institutions set up to ensure the specification of anticipation duties under the HRS and their implementation, the international institutions must be *public* institutions. WHO's funding structure and its ever-increasing reliance on PPPs to determine its work priorities and their delivery raise questions in this regard,[257] including in the area of granting EULs for investigational medical products. Member states' contributions, in particular to the non-earmarked budget, shrank continuously over the years, with private actors such as the BMGF and *Gavi* among the biggest contributors to WHO's 2020–23 budgets; and pharmaceutical companies also among the contributors.[258] As indicated: BMGF, *Gavi* and the *Wellcome* Trust are highly intertwined with the pharmaceutical industry.[259] *Gavi* is an observer in many WHO technical committees, including for example in SAGE[260] and GACVS,[261] and – despite being structured as a PPP – has been granted privileges and immunities in 2009.[262] Against the background of WHO industry-bias during the 2009 Swine Flu pandemic,[263] these developments must be evaluated critically if the HRS is to be realised in the medical-scientific field with the support of the WHO.

6. Concluding remarks

This piece made an initial attempt to sketch the domestic and international institutional framework that states shall set up to implement their anticipatory duties flowing from the HRS and, at the same time, enable international institutions to comply with their anticipatory responsibilities for the HRS. The example of the scientific response to the appearance of SARS-CoV-2 in late 2019 has been used to concretise this framework including by highlighting the shortcomings of the current framework.

Building on the understanding of science as a communal and open-ended endeavour of knowledge seeking in which everyone has a right to participate, to benefit from and to be protected against harm arising from it, as well as the importance of scientific freedom, the piece elaborated on states' duties under the HRS to anticipate both the benefits and harm of science, and to promote the former and protect against the latter with reasonable care (due diligence). These duties encompass more positive duties to 'protect' and to 'fulfil' as well as more negative duties to 'respect'. Their exact shape must be determined in context, taking account of many aspects, e.g. the severity of potential harm and the degree of risk of harm, the size of expected benefits and the likelihood of them to materialise, the availability of resources, the (collective) social, cultural, religious, economic or financial preferences that a certain 'democratic society' has and the control that the respective state institutions of jurisdiction as anticipation duty-bearers have over (opportunities for) benefits and (risks of) harm of science. The specification of anticipation duties shall be done through informed democratic (participative) processes, respecting the political equality of all members of 'democratic societies' and the cores of their human rights. They may, however, also involve the expertise of specialised domestic institutions.

Domestic and international institutions are thus required to (co-)specify anticipatory duties under the HRS and coordinate their implementation. Domestic public

institutions, in particular legislatures, remain key here, as they can indeed exercise democratic control over and shape the domestic communal scientific endeavour including the promotion of its benefits and the protection against harm resulting from it along egalitarian lines. Of course, an independent judiciary and domestic specialised public institutions, e.g. a medical agency, a science funding institution, an ethics council, etc. are also required to carefully identify, determine and secure the anticipation duties under the HRS. The example of GoF-research with SARS-CoV viruses, the large-scale rollout of investigational vaccines and the suppression of effective early treatment protocols for Covid-19 and the harm this has caused illustrated however that even at domestic level, the institutional framework in many countries has been unable to comply with its anticipation duties under the HRS. A significant problem in this context is the general privatised and commercialised character of the current scientific enterprise which leads to a situation in which domestic institutions do no longer have access to all relevant knowledge, data and expertise to openly debate and assess the benefits and harm of science and to allocate sufficient public resources to fund results-open scientific projects. Moreover, the public – private divide is threatened by excessive lobbying, astroturfing and regulatory capture of (formally) public institutions, as well as the extensive reliance on PPPs or the outright privatisation of scientific processes and activities. Efforts towards ensuring true democratic control over public institutions, going beyond the requirement that single persons must declare their conflicts of interests should be taken to secure the HRS institutionally at the domestic level. In addition, more research is needed to clarify the best modes of interaction between independent specialised domestic (science) institutions like universities, research institutions and medical agencies on the one hand and legislatures, executive authorities and judiciaries on the other hand in order to indeed secure the effective prevention or mitigation of (risks of) harm and the promotion of (opportunities for) benefits of science in line with the (local) preferences of the respective democratic societies represented in, and acting through, these institutions.

The analysis then revealed that the problems are aggravated at the level of international institutions which should, in principle, enable states to co-specify their domestic anticipation duties under the HRS and to coordinate their implementation. This is essential when protection against (risk of) harm and promotion of (opportunities for) benefits of science is possible only through such cooperation and coordination due to the global nature of the harm and benefit, and, more generally, due to the communal character of science underlying the HRS. To effectively comply with their anticipatory responsibilities for the HRS, international institutions would need to work along egalitarian lines too. At the very least, this would mean that decisions taken by international institutions on the promotion of some scientific innovations and the suppression of others are linked to the decisions taken by democratic states, and that these international institutions clearly remain public institutions. However, further institutional innovation is called for.

Future research should thus engage in more detail with the question of international institutional design in particular, ensuring that these institutions are public institutions, work with respect for the sovereign equality of all states, offer additional opportunities for public participation and genuinely promote scientific freedom, the openness of science and its benefits, and protect against its harm. This is essential to secure the HRS with

science as a (global) communal endeavour that leads humanity to use science and its applications with discernment.

Notes

1. Art.15(1)(b) International Covenant on Economic, Social and Cultural Rights (ICESCR), 993 UNTS 3, entered into force 3 January 1976; Art.27(1) Universal Declaration of Human Rights (UDHR), UNGA Res 217A, 10 Dec 1948.
2. CESCR, General Comment 25 – On Science and Economic, Social and Cultural Rights, E/C.12/GC/25, 3 April 2020, paras.8 and 56; Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and its Applications, 2009, paras.13(a) and (c); Report of the UN Special Rapporteur in the Field of Cultural Rights, Farida Shaheed, The Right to Enjoy the Benefits of Scientific Progress and its Applications, A/HRC/20/26, 14 May 2012, para.43.
3. Indirect privatisation would include e.g. the funding of universities and other public research institutions, as well as of (public) medical agencies and the WHO by the pharmaceutical industry and/or by philanthropic organisations like the Bill and Melinda Gates Foundation (BMGF) and its Vaccine Alliance *Gavi*, or the *Wellcome* Trust that have extensive links with the pharmaceutical industry. See also section 5.1.d) below.
4. This problem has been identified for a long time already, e.g. Venice Statement, para.5; Audrey Chapman, 'Towards an Understanding of the Right to Enjoy the Benefits of Scientific Progress and its Applications', *Journal of Human Rights* 8 (2009): 1, 19 and 23; Yvonne Donders, 'The Right to Enjoy the Benefits of Scientific Progress: In Search of State Obligations in Relation to Health', *Medicine, Health Care and Philosophy* 14 (2011): 371, 380; William Schabas, 'Study of the Right to Enjoy the Benefits of Scientific and Technological Progress and Its Applications', in *Human Rights in Education, Science and Culture: Legal Developments and Challenges*, ed. Donders and Volodin (Ashgate/UNESCO, 2007) 273, 297; Lea Shaver, 'The Right to Science and Culture', *Wisconsin Law Review* 1 (2010): 12; and Lea Shaver, 'Ensuring that Everyone Benefits from Scientific and Technological Progress', *European Journal of Human Rights* 4 (2015): 411, 417; Sebastian Porsdam Mann, Helle Porsdam and Yvonne Donders, '"Sleeping Beauty": The Right to Science as a Global Ethical Discourse', *Human Rights Quarterly* 42 (2020): 332, 352–3.
5. For the area of clinical research, see e.g. Jon Jureidini and Leemon McHenry, *The Illusion of Evidence-Based Medicine. Exposing the Crisis of Credibility in Clinical Research* (Wakefield Press, 2020); and Ben Goldacre, *Bad Pharma: How Drug Companies Mislead Doctors and Harm Patients* (Fourth Estate, 2012), noting that already in 2012, 90% of published clinical trials were sponsored by the pharmaceutical industry (172).
6. See e.g. Katie Pearse, '"Follow the Science" and other Principles of Biden's Pandemic Response Plan', John Hopkins University Hub, 15 January 2021, https://hub.jhu.edu/2021/01/15/biden-covid-response-hopkins-alums/; 'Continuing to Follow the Science: An Open Letter from Pfizer Chairman and CEO Dr. Albert Bourla', December 2021, https://www.pfizer.com/news/announcements/continuing-follow-science-open-letter-pfizer-chairman-and-ceo-dr-albert-bourla; and Gonzalo Muñoz and Nigel Topping, 'Following the Science Means Slashing Emissions 7% per Year – Starting Now', Climate Home News, 13 August 2021, https://climatechangenews.com/2021/08/13/following-science-means-slashing-emissions-7-per-year-now/. This slogan is misleading as there is no one science. On the contrary, the essence of science is the open-ended search for new knowledge through dialectic processes.
7. See e.g. the 2019 Strategic Partnership Framework signed between the UN and the World Economic Forum (WEF), https://www.weforum.org/press/2019/06/world-econoic-forum-and-un-sign-strategic-partnership-framework. An open letter to the UN Secretary General of 400+ civil society organisations 'End the United Nations/World Economic

Forum Partnership Agreement' (25 September 2019), https://www.tni.org/en/article/end-the-united-nationsworld-economic-forum-partnership-agreement, observed that this agreement formalised the corporate capture of the UN, moving towards an increasingly privatised and less democratic form of global governance.

8. For a critical analysis of far-reaching privatisation of activities traditionally performed by states undermining the enjoyment of human rights and the functioning of democratic systems see Report of the UN Special Rapporteur on the Extreme Poverty and Human Rights, Philip Alston, A/73/396, 26 Sept 2018.
9. Panagis Polykretis and Peter McCullough, 'Rational Harm-Benefit Assessments by Age Group are Required for Continued Covid-19 Vaccination' *Scandinavian Journal of Immunology* 98 (2022): e13242.
10. John Cohen, '2020 Breakthrough of the Year: Shots of Hope', *Science*, 17 December 2020.
11. There is mounting evidence that SARS-CoV-2 is the result of so-called gain-of-function (GoF) research which is most likely in violation of the 1972 UN Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (BWC), 1015 UNTS 163. See e.g. Sharon Lerner *et al.,* 'NIH Documents Provide New Evidence U.S. Funded Gain-of-Function Research in Wuhan', *The Intercept*, 10 September 2021, https://theintercept.com/2021/09/09/covid-origins-gain-of-function-research; Katherine Eban, '"This Shouldn't Happen": Inside the Virus-Hunting Non-profit at the Center of the Lab-Leak Controversy', *Vanity Fair*, 31 March 2022, https://www.vanityfair.com/news/2022/03/the-virus-hunting-non-profit-at-the-center-of-the-lab-leak-controversy; 'Why the Chair of the *Lancet's* Covid-19 Commission Thinks the US Government is Preventing a Real Investigation into the Pandemic', interview with Prof. Jeffrey Sachs, *Current Affairs*, 2 August 2022, https://currentaffairs.org/2022/08/why-the-chair-of-the-covid-19-commission-thinks-the-us-government-is-preventing-a-real-investigation-into-the-pandemic; and Roland Wiesendanger, Studie zum Ursprung der Coronavirus-Pandemie, *Preprint*, Research Gate, February 2021, https://www.researchgate.net/publication/349302406_Studie_zum_Ursprung_der_Coronavirus-Pandemie.
12. See e.g. Andrew Bryant *et al.*, 'Ivermectin for Prevention and Treatment of Covid-19 Infection: A Systematic Review, Meta-Analysis, and Trial Sequential Analysis to Inform Clinical Guidelines', *American Journal of Therapeutics* 28 (2021): e434; Lucy Kerr *et al.,* 'Regular Use of Ivermectin as Prophylaxis for COVID-19 Led Up to a 92% Reduction in COVID-19 Mortality Rate in a Dose-Response Manner: Results of a Prospective Observational Study of a Strictly Controlled Population of 88,012 Subjects', *Cureus* 14, no.8 (2022): e28624; Pierre Kory *et al.,* 'Review of the Emerging Evidence Demonstrating the Efficacy of Ivermectin in the Prophylaxis and Treatment of COVID-19', *American Journal of Therapeutics* 28, no.3 (2021): e299; Peter McCullough *et al.*, 'Pathophysiological Basis and Rationale for Early Treatment of SARS-CoV-2 (COVID-19) Infection', *American Journal of Medicine* 134, no.1, (2021): 16; and collection of 'Covid-19 Treatment Studies for Ivermectin', available at https://c19ivm.org.
13. Samantha Besson, 'Science without Borders and the Boundaries of Human Rights: Who Owes the Human Right to Science?', *European Journal of Human Rights* 4 (2015): 462, 481.
14. According to its Constitution and mandate, WHO is not a global medical regulator. However, it more and more acts as one when it declares a Public Health Emergency of International Concern (PHEIC) under the International Health Regulations (IHR) (2509 UNTS 79, entered into force 15 June 2007) and subsequently issues Emergency Use Listings (EULs) to non-licensed medical products that are then distributed around the world.
15. See COVAX-facility, https://www.gavi.org/covax-facility. Covax is the vaccines pillar of the Access to COVID-19 Tools (ACT) Accelerator, https://www.act-a.org.
16. See: COVAX: CEPI's response to COVID-19, https://cepi.net/covax/.
17. *Cepi* was wounded as a partnership between the World Economic Forum (WEF), the Norwegian and Indian governments, the Bill and Melinda Gates Foundation (BMGF) and the GlaxoSmithKline foundation and the *Wellcome* Trust. See: www.cepi.net/about/whoweare.

18. In line with Art.12 IHR. WHO Covid-19-Emgergency Committee (WHO-Covid-19-EC), Statement on the Second Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Outbreak of Novel Coronavirus (2019-nCoV), 30 January 2020, available at: https://www.who.int/groups/covid-19-ihr-emergency-committee.
19. The IFR indicates the risk of death if infected. Overall, in 2021, Covid-19 had an average IFR of 0.15% (reduced to an average of 0.05% for people under 70). See the evolving work of John Ioannidis: John Ioannidis, 'Infection Fatality Rate of Covid-19 Inferred from Seroprevalence Data', *Bulletin of the World Health Organization* 99 (2021): 19; John Ioannidis, 'Reconciling Estimates of Global Spread and Infection Fatality Rates of COVID-19: An Overview of Systematic Evaluations', *European Journal of Clinical Investigation* 51, no.5 (2021): 1; and Angelo Maria Pezzullo *et al.*, 'Age-stratified Infection Fatality Rate of COVID-19 in the Non-elderly Population', *Environmental Research* 216 (2022): 114655, concluding that the median IFR was 0.0003% at 0–19 years, 0.002% at 20–29 years, 0.011% at 30–39 years, 0.035% at 40–49 years, 0.123% at 50–59 years, and 0.506% at 60–69 years. To compare: Seasonal influenza has an average IFR of 0,16%, Ebola of 50%.
20. WHO-Covid-19-EC, Statement on the Fifteenth Meeting of the International Health Regulation (2005) Emergency Committee on the Covid-19 Pandemic, 5 May 2023, available at: https://www.who.int/groups/covid-19-ihr-emergency-committee.
21. In accordance with Arts.15–17 IHR. WHO recommendations for medical and non-medical countermeasures to address the Covid-19-PHEIC are available at: https://www.who.int/groups/covid-19-ihr-emergency-committee.
22. See e.g. WHO, Non-pharmaceutical Public Health Measures for Mitigating the Risk and Impact of Epidemic and Pandemic Influenza, 19 September 2019. For more details and fully developed arguments, see Silvia Behrendt and Amrei Müller, 'Do we Need to Protect the Entire World Population from Health Threats through One Global Biomedical Surveillance and Response System? A Human Rights-Based Comment on the Proposed WHO Treaty on Pandemic Preparedness and Response', *German Yearbook of International Law* 64 (2021): 41, 69–72.
23. For a detailed anaylsis, including the integration of the GHS into international health law, see Behrendt/Müller, 'Do we Need'; Silvia Behrendt and Amrei Müller, 'Vergisst die WHO über ihren sicherheitsfokussierten Ansatz der Covid-19-Pandemiebekämpfung den Menschenrechtsschutz?' (Teil 1), *Jusletter*, 20 December 2021; Silvia Behrendt and Amrei Müller, 'Vergisst die WHO über ihren sicherheitsfokussierten Ansatz der Covid-19-Pandemiebekämpfung den Menschenrechtsschutz?' (Teil 2), *Jusletter*, 24 January 2022.
24. See sources cited in *supra* note 11.
25. Potentially illegal under the 1972 BWC and the 1925 Geneva Gas Protocol. Art.1(1) BWC contains an exception in that it does not prohibit research with 'microbial or other biological agents' that is for 'prophylactic, protective or other peaceful purposes'. This excludes research for the development of any *defensive* or offensive bioweapons (see e.g. Jozef Goldblat, 'The Biological Weapons Convention', *International Review of the Red Cross* 318 (1997): 251, 254). However, the US has interpreted this exception so broadly to justify its 'defensive' bioweapons programme that it arguably undermines the object and purpose of the BWC which, as set out in the BWC's preamble, is to 'exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons' (neither offensively nor defensively). For a detailed analysis, Francis Boyle, *Biowarfare and Terrorism* (Clarity Press, 2005), 16–18, 69 and 71–74.
26. See ibid. the analysis of the US Biowarfare Program, involving numerous US and non-US universities as well as US federal agencies like the National Institute of Health (NIH) overseeing biomedical research and its sub-agency, the National Institute for Allergy and Infectious Diseases (NIAID), especially since 09/11; and Csaba Bence Farkas *et al.*, 'Analysis of the Virus SARS-CoV-2 as a Potential Bioweapon in Light of International Literature', *Military Medicine* (2022), published online 16 May 2022.
27. These products are not traditional vaccines but gene therapy products and should have been classified as such by the regulatory agencies, see Helene Banoun, 'mRNA: Vaccine or Gene

Therapy? The Safety Regulatory Issues', *International Journal of Molecular Science* 24 (2023): 10514.

28. WHO, Covid-19 Research and Innovation Achievements, April 2022, 6, https://www.who.int/publications/m/item/covid-19-research-and-innovation-achievements.
29. See statements by WHO European Director, Hans Kluge, 3 December 2020, htpps://www.reuters.com/article/us-health-coronavirus-who-idUSKPBN28D1K0.
30. Donald Trump: https://www.nbcnews.com/politics/donald-trump/trump-renews-praise-covid-vaccines-one-greatest-achievements-mankind-n1286551
31. Moncef Slaoui and Matthew Hepburn, 'Developing Safe and Effective Covid Vaccines – Operation Warp Speed's Strategy and Approach', *New England Journal of Medicine* 383, no.18 (2020):1701.
32. Banoun, 'mRNA: Vaccine or Gene Therapy?', 1; Polykretis and McCullough, 'Rational Harm-Benefit Assessments by Age Group', e13242.
33. This is due to the fact that both *Pfizer* and *Moderna* disbanded their control groups in early 2021 (see EMA Committee for Medicinal Products for Human Use (CHMP), Assessment report on the annual renewal of the conditional marketing authorisation Procedure no. EMEA/H/C/005735/R/0046, https://www.ema.europa.eu/en/documents/variation-report/cominrnaty-h-c-5735-r-0137-epar-assessment-report-renewal_en.pdf; and Moderna, 'Moderna Provides Clinical and Supply Updates on Covid-19 Vaccine Program Ahead of 2nd Annual Vaccines Day', 13 April 2021, https://s29.q4cdn.com/435878511/files/doc_news/2021/04/13/moderna-provides-clinical-and-supply-updates-covid-19-vaccine.pdf. With this, both companies failed to comply with the requirements based on which EMA had granted their products conditional marketing authorisation. See also Banoun, 'mRNA: Vaccine or Gene Therapy?', 12.
34. EMA's conditional marketing authorisation process explained: https://www.ema.europa.eu/en/human-regulatory/marketing-authorisation/conditional-marketing-authorisation.
35. WHO, Emergency Use Listing Procedure, 9 August 2022, https://www.who.int/publications/m/item/emergency-use-listing-procedure; for details on WHO's EUL procedure, see Behrendt/Müller, 'Do we Need', section III.B.3).
36. See: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC1130(03)&from=EN
37. WHO, Status of COVID-19 Vaccines within WHO EUL/PQ Evaluation Process, 29 May 2023, https://extranet.who.int/prequal/sites/default/files/documents_files/Status_COVID_VAX_29May2023.pdf.
38. As confirmed on WHO's Q&A website on the EUL procedure, https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-use-of-emergency-use-listing-procedure-forvaccines-against-covid-19; and e.g., *BioNTech/Pfizer* must submit the pivotal study results for its Covid-19 vaccine *Comirnaty* (C4591001) only in December 2023 (WHO, *Recommendation for an Emergency Use Listing of Tozinameran (Covid-19 mRNA Vaccine (nucleoside modified)) submitted by BioNTech Manufacturing GmbH*, 26 January 2021, https://extranet.who.int/prequal/sites/default/files/documents/TAG-EUL_PublicReport_BioNTech_DEC20). This is unlikely to happen as control groups have been disbanded.
39. E.g. WHO, *Emergency Use Designation of COVID-19 Candidate Vaccines: Ethical Considerations for Current and Future COVID-19 Placebo-controlled Vaccine Trials and Trial Unblinding*, 18 December 2020, 1 and 4, https://www.who.int/publications/i/item/WHO-2019-nCoV-Policy_Brief-EUD_placebo-controlled_vaccine_trials-2020.1; and WHO Ad Hoc Expert Group on the Next Steps for Covid-19 Vaccine Evaluation, 'Placebo-Controlled Trials of Covid-19 Vaccines – Why we still Need Them', *New England Journal Medicine* 384, no.2 (2021): e2(1), e2(1)-e2(2).
40. WHO, Emergency Use Listing Procedure, 9 August 2022, 7 (emphasis added).
41. Obtaining an EUL from WHO is a precondition for a product to then be distributed globally via *Covax,* see WHO, *Product Eligibility under the COVAX Facility,* 29 December 2020. This indicates that EUL designations can have *de facto* regulatory consequences.

42. See e.g. WHO-Covid-19-EC, Statement on the Eighth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 15 July 2021, rec.3 to State parties (10%); Statement on the Ninth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 26 Oct 2021, rec.3 to state parties (40%); Statement on the Tenth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 19 January 2022, rec.3 to state parties (70%); Statement on Twelfths Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic (12 July 2022), rec.3 to states parties ('achieve the highest possible vaccination coverage among persons at highest risk of severe disease outcomes and among persons at highest risk of exposure, health workers, the elderly and other priority groups' including a 'booster dose'); Statement on the Fourteenth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 30 January 2023, rec.1 ('achieve 100% [vaccination] coverage of high-priority groups'). All statements available at: https://www.who.int/groups/covid-19-ihr-emergency-committee.
43. For details on these measures see Behrendt/Müller, 'Do we Need', section B.3; and Behrendt/Müller, 'Vergisst die WHO (Teil 2), section 4.
44. See sources listed in *supra* note 12.
45. See e.g. WHO, 'Therapeutics and Covid-19: Living Guidelines. 16 September 2022', https://www.who.int/publications/i/item/WHO-2019-nCoV-therapeutics-2022.5
46. See the video report by Dr. Tess Lawrie concerning *Ivermectin*: 'Dr. Tess Lawrie Provides an Exclusive Inside into Her Conversation with Dr. Andrew Hill', 20 December 2021, https://worldcouncilforhealth.org/multimedia/tess-lawrie-andrew-hill/.
47. WHO, Infodemic; Tina Purnat *et al.* (eds), *Managing Infodemics in the 21st Century. Addressing New Public Health Challenges in the Information Ecosystem* (Springer, 2023).
48. As analysed in detail by Behrendt/Müller, 'Vergisst die WHO (Teil 1)', 27–30; Behrendt/Müller, 'Vergisst die WHO (Teil 2)', 19–21. See also the recent insights from documents released by the US Centre for Disease Control (CDC) in response to requests under the US Freedom of Information Act obtained by *America First Legal*, 'AFL Lawsuit Reveals Damning CDC Documents Proving Government Collusion with Big Tech to Censor Free Speech and Promote Biden Administration Propaganda', 27 July 2022, https://aflegal.org/afl-lawsuit-reveals-damning-cdc-documents-proving-government-collusion-with-big-tech-to-censor-free-speech-and-promote-biden-administration-propaganda/.
49. WHO, 'Combatting Misinformation Online', htpps://www.who.int/teams/digital-health-and-innovation/digital-channels/combating-misinformation-online. For a description and analysis of the effects of these policies on leading doctors, scientists and professors see Yaffa Shir-Raz *et al.*, 'Censorship and Suppression of Covid-19 Heterodoxy: Tactics and Counter-Tactics', *Minerva* 61 (2022): 407; and Paul Thacker, 'The Journal *Vaccine* Publishes Study Finding Serious Side Effects of COVID-19 Vaccines, Despite Three Dodgy Fact Checks and Facebook Censoring', *Substack – The DisInformation Chronicle*, 6 Sept 2022, https://disinformationchronicle.substack.com/p/the-journal-vaccine-publishes-study.
50. WHO, Covid-19 Advice for the Public: Getting Vaccinated, 13 April 2022, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice: 'It is still possible to get COVID-19 and spread it to others after being vaccinated, so continue to do everything you can to keep yourself and others healthy.'
51. Piero Olliearo *et al.,* 'Covid-19 Vaccine Efficacy and Effectiveness – The Elephant (Not) in the Room', *Lancet Microbe* 7, no.2 (2021): e279.
52. Especially those by *BioNTech/Pfizer* and *Moderna*, see e.g. Peter Doshi, 'Will Covid-Vaccines Save Lives? Current Trials are not Designed to Tell Us', *British Medical Journal* 371 (2020): m4037; Peter Doshi, 'Pfizer and Moderna's "95% Effective" Vaccines – We Need more Details and the Raw Data', *thebmjopinion*, 4 January 2021; Peter Doshi, 'Clarification: Pfizer and Modern's "95% Effective" Vaccines – We Need more Details and the Raw Data'

thebmjopinion, 5 February 2021; and Paul Thacker, 'Covid-19: Researcher Blows the Whistle on Data Integrity Issues in *Pfizer's* Vaccine Trial', *British Medical Journal* 375 (2021): n2635. See also the more recent analysis of *Pfizer Documents* released as a result of a request under the US Freedom of Information Act: Daily Clout (ed), *Pfizer Documents Analysis Reports* (2022), https://dailyclout.io/product/war-room-dailyclout-pfizer-documents-analysis-volunteers-reports/.

53. Vaccine Adverse Event Reporting System (*VAERS*), https://vears.hhs.gov. Current and reformatted US data at Openvears, *VAERS COVID Vaccine Adverse Event Reports, https://openvaers.com/covid-data*.
54. EudraVigilance, European Database of Suspected Adverse Drug Reaction Reports, https://www.adrreport.eu/en/index.html.
55. Data from WHO Database *VigiAccess*, concerning all Covid-19 vaccines, https://www.vigiaccess.org.
56. To compare, see Pedro Moro *et al*., 'Deaths Reported to the Vaccine Adverse Event Reporting System, United States, 1997–2013' *Clinical Infectious Diseases* 61, no.6 (2015): 980; and the comparative analysis of *VigiAccess* reports on adverse reactions after Covid-19 vaccinations with reports on adverse reactions after traditional vaccinations (14 July 2022), see Transparenztest, *WHO* VigiAccess *Datenbank: 4.029.255 Reports mit 9.609.672 einzelnen Impf-Nebenwirkungen gemeldet,* https://www.transprenztest.de/post/who-vigiaccess-datenbank-4029255-reports-mit-6960672-einzelnen-impf-nebenwirkungen.
57. As of July 2023, there is a total of 1,572,923 reports on adverse events in *VEARS*; 2,249,120 reports in *EudraVigilance* and 5,038,156 reports in *VigiAccess*. By far not all adverse effects are reported, see Lorna Hazell and Saad Shakir, 'Under-reporting of Adverse Drug Reactions: A Systematic Review', *Drug Safety* 29, no.5 (2006): 385, indicating an underreporting rate of 95%.
58. Joseph Fraiman *et al*., 'Serious Adverse Events of Special Interest Following mRNA COVID-19 Vaccination in Randomized Trials in Adults', *Vaccines* 40 (2022): 5798, finding 1 serious adverse event for each 800 vaccinees. To compare: other vaccines have been withdrawn from the market when one serious adverse occurred in one per 10,000 vaccinees, e.g. Lee Hampton *et al*., 'General Determination of Causation Between Covid-19 Vaccines and Possible Adverse Effects', *Vaccines* 39 (2021): 1478, 1479.
59. For a few recent reviews with concerning results, see Stephanie Seneff *et al*., 'Innate Immune Suppression by SARS-CoV-2 mRNA Vaccinations: The Role of G-quadruplexes, Exosomes, and MicroRNAs', *Food and Chemical Toxicology* 164 (2022): 113008; Fraiman *et al*., 'Serious Adverse Events'; Aseem Malhotra, 'Curing the Pandemic of Misinformation on Covid-19 mRNA Vaccines through Real Evidence-based Medicine – Part 1', *Journal of Insulin Resistance* 5, no.1 (2022): a71 and Aseem Malhotra, 'Curing the Pandemic of Misinformation on Covid-19 mRNA Vaccines through Real Evidence-based Medicine – Part 2', *Journal of Insulin Resistance* 5, no.1 (2022): a72; Mark Skidmore, 'The Role of Social Circle COVID–19 Illness and Vaccination Experiences in COVID–19 Vaccination Decisions: An Online Survey of the United States Population', *BMC Infectious Diseases* 23 (2023): 51; Vladimir Uversky *et al*., 'IgG4 Antibodies Induced by Repeated Vaccination May Generate Immune Tolerance to the SARS-CoV-2 Spike Protein', *Vaccines* 11 (2023): 991; Max Schmeling *et al*., 'Batch-dependent Safety of the BNT162b2 mRNA Covid-19 Vaccine' *European Journal of Clinical Investigation* 53 (2023): e13998; Gretchen Vogel and Jennifer Couzin-Frankel, 'Studies Probe Covid-19 Shots' Link to Rare Symptoms. Details Emerge for Uncommon Cases of Neurologic Complications, Blood Pressure Swings, and Other Side Effects', *Science* 381 (2023): 18; Fadi Nahab *et al*., Factors Associated with Stroke after Covid-19 Vaccination: A Statewide Analysis', *Frontiers in Neurology* 14 (2023): 1199745; Josef Finsterer, 'Neurological Adverse Reactions to SARS-CoV-2 Vaccines', *Clinical Psychopharmacology and Neuroscience* 21, no. 2 (2023): 222.
60. As planned e.g. under *Cepi's* 100 Days initiative, https://100days.cepi.net.
61. See WHO, Global Digital Health Certification Network, https://www.who.int/initiatives/global-digital-health-certification-network.

62. These directions are observable in the on-going negotiation process under the auspices of WHO of the new treaty on pandemic preparedness and response and the parallel revision of the IHR. For an analysis, see Behrendt/Müller, 'Do we Need'; and Silvia Behrendt and Amrei Müller, The Proposed Amendments to the International Health Regulations: An Analysis, *Opinio Juris*, 27 Feb 2023.
63. CESCR, General Comment 25, paras.8 and 56.
64. E.g. Klaus Beiter, 'Where Have all the Scientific and Academic Freedoms Gone? And What is 'Adequate for Science?' The Right to Enjoy the Benefits of Scientific Progress and its Applications', *Israel Law Review* 52, no.2 (2019): 233, 283; and Donders, 'In Search of State Obligations', 372–3; and Jessica Wyndham and Margaret Weigers Vitullo, 'The Right to Science – Whose Right? To What?', *European Journal of Human Rights* 4 (2015): 431, section III.
65. E.g. Venice Statement, paras.13(a), (b) and (c).
66. As all other human rights, this right is held also by individuals who have not contributed directly to the scientific processes and their results. See e.g. Porsdam Mann, Porsdam and Donders, 'Sleeping Beauty', 336 and 343; and Hans Morten Haugen, 'Human Rights and Technology – A Conflictual Relationship? Assessing Private Research and the Right to Adequate Food', *Journal of Human Rights* 4 (2008): 224, 232.
67. Art.15(3) ICESCR; CESCR, General Comment 25, paras.13–15; Venice Statement, paras.8, 14(a) and (b); UNSR Report (2012) on HRS, paras.8 and 39–42. Discussing the 'freedom dimension' in particular see Beiter, 'Where have all the Freedoms Gone?'.
68. Art.15(4) ICESCR; CESCR, General Comment 25, paras.45, 51–52, 74 and 77–84; Venice Statement, paras.12 g) and 16 d); UNSR Report (2012) on HRS, paras.8, 12, 15 and 17.
69. This participatory element is directly spelt out in Art.27 UDHR as pointed out in CESCR, General Comment 25, para.10 (including fn.6).
70. This communal element of the HRS is also underlined by the proximity of the HRS to the right to take part in cultural life set out in Art.15(1)(a) ICESCR, as recognised in CESCR, General Comment 25, paras.9–11. See also Mylene Bidault, 'Considering the Right to Enjoy the Benefits of Scientific Progress and Its Applications As a Cultural Right. A Change in Perspective', in *The Right to Science. Then and Now*, ed. Helle Porsdam and Sebastian Porsdam-Mann (CUP, 2022), 140.
71. On the notion of citizen scientists, see Effy Vayna and John Tasioulas, '"We the Scientists": A Human Right to Citizen Science', *Philosophy & Technolology* 28 (2015): 479.
72. As indicated by the definition of 'science' in the UNESCO Recommendation on Science and Scientific Researchers, UNESCO Doc 39 C/Res 85, 13 November 2017, para.1(a), a definition that was also adopted in the CESCR's General Comment 25, para.4.
73. CESCR, General Comment 25, para.5. Note, however, that this contribution focuses primarily on natural (medical) science.
74. Ibid.
75. This distinguishes the HRS from the right to education set out in Art.13 ICESCR. See also Audrey Chapman, 'Towards an Understanding of the Right to Enjoy the Benefits of Scientific Progress and its Applications', *Journal of Human Rights* 8 (2009):1, 7.
76. See analyses by Tara Smith, 'Scientific Purpose and Human Rights: Evaluating General Comment No 25 in Light of Major Discussions in the *Travaux Preparatoires* of the Universal Declaration on Human Rights and International Covenant on Economic, Social and Cultural Rights', *Nordic Journal of Human Rights* 38, no.3 (2020): 221; and Tara Smith, 'Understanding the Nature and Scope of the Right to Science through the *Travaux Preparatoires* of the Universal Declaration on Human Rights and the International Covenant on Economic, Social and Cultural Rights', *International Journal of Human Rights* 24, no. 8, (2020): 1156.
77. Smith, 'Evaluating General Comment 25', 226–9.
78. Beiter, 'Where Have All the Freedoms Gone?', 250–5.
79. Ibid., 240.

80. However, with the exception of voicing some critique of granting excessively broad intellectual property rights, the CESCR does not object to the privatisation of the scientific enterprise but considers it 'instrumental' for the enjoyment of the HRS (see General Comment 25, paras.58–59). For a convincing argument to the contrary, though concerning the general trend to argue that a 'human-rights-compliant regulatory regime can be transferred to the private sector' (para.84), see Report of the UNSR on Extreme Poverty (2018).
81. Lea Shaver, 'The Right to Science and Culture', *Wisconsin Law Review* 1 (2010): 121, 128; see also Beiter, 'Where are all the Freedoms Gone?', warning against corporatism in science (especially the university context), 261–9 and 281 that undermines the enjoyment of HRS.
82. Of course, anyone engaging in scientific processes that result in 'benefits and applications' in the access to which everyone has a right to 'benefit(s) from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author' under Article 15(1)(c) ICESCR. As set out in CESCR, General Comment 17: The Right of Everyone to Benefit from the Protection of the Moral and Material Interests Resulting from any Scientific, Literary or Artistic Production of Which He or She is the Author, E/C.12/GC/17, 12 January 2006, this provision aims to ensure that authors enjoy an adequate standard of living and are recognised as the creators of their production (paras.12–16), but does not offer the extensive legal protection offered e.g. by current IP law (para.10).
83. CESCR, General Comment 25, para.13.
84. Ibid., paras.54–55, 75 and 87.
85. Ibid.; and UNSR Report (2012) on HRS, para.22; Venice Statement, para.16(a); and Porsdam Mann, Porsdam and Donders, 'Sleeping Beauty', 349.
86. Harms that potentially undermine states' abilities to comply with minimum core obligations flowing from the HRS and other human rights cannot, of course, be justified even if 'accepted' through a democratic process. The inherent core of all human rights act as 'egalitarian limits' to democratic processes dominated by majority decisions.
87. CESCR, General Comment 25, para.56, and references to democracy in paras.37, 54 and 87; UNSR Report (2012) on HRS, paras.43 and 74(h); also implied in Venice Statement, paras.16(c) and (e).
88. UNSR Report (2012) on HRS, paras.33, 43 and 55; and Porsdam Mann, Porsdam and Donders, 'Sleeping Beauty', 344.
89. See e.g. Samantha Besson, 'Human Rights and Democracy in a Global Context: Decoupling and Recoupling', *Ethics & Global Politics* 4 (2011): 19.
90. Arts.2(1), 14(1), 26 ICCPR; Arts.2(2) and 3 ICESCR; Art.14 ECHR. Interpreted e.g. by HRCttee, General Comment 18 – Non-discrimination, HRI/GEN/1/Rev.1, 10 Nov 1989; CESCR, General Comment 20 – Non-discrimination in Economic, Social and Cultural Rights, E/C.12/GC/20, 2 July 2009.
91. E.g. Art.15 ICCPR; Art.15 UDHR; Art.3 P-I to the ECHR. Interpreted by HRCttee, General Comment 25 – The Right to Participate in Public Affairs, Voting Rights and the Right of Equal Access to Public Service, CCPR/C/21/Rev.1/Add.7, 12 July 1996.
92. Arts.14(1), 21 and 22(2) ICCPR; Arts 4 and 8(1)(a) and (c) ICESCR; Arts. 8(2)-11(2) ECHR.
93. CESCR, General Comment 25, paras.6 and 52.
94. Ibid., paras.13–15.
95. This follows the essential subtle distinction between duties and responsibilities Samantha Besson draws in her work, especially Besson 'Science without Borders', 462–85; and Samantha Besson, 'The Bearers of Human Rights' Duties and Responsibilities for Human Rights – A Quiet (R)Evolution', *Social Philosophy & Policy* 32, no. 1 (2015): 244–68.
96. Concrete human rights duties arise for states that are parties to human rights treaties out of relationships of jurisdiction with concrete individuals, see e.g. Art.2(1) ICCPR; Art.2 OP-ICESCR; Art.1 ECHR.
97. This can be inferred from the CESCR's reference to the precautionary principle in its General Comment 25, para.56. See also Andrea Boggio, 'The Right to Participate in and Enjoy the Benefits of Scientific Progress and Its Applications: A Conceptual Map', *New York International Law Review* 34, no.2 (2021): 43, 49; and Yvonne Donders and

Monika Plozza, 'Look Before you Leap: States' Prevention and Anticipation Duties under the Right to Science', 2023, in this *Special Issue*.

98. As at least indirectly hinted at in CESCR, General Comment 25, paras.74 and 1.
99. Curiously, the CESCR only mentions the due diligence standard in relation to states' duties to impose this standard of conduct on international corporations, presumably via domestic private law (see CESCR, General Comment 25, para.75). It does not (directly) indicate that the due diligence standard first and foremost describes states' duties to anticipate (risks of) harm and (opportunities for) benefits of science under the HRS. See also Samantha Besson, 'Anticipation under the Human Right to Science: Concepts, Stakes, Specificities', 2023, introduction to this *Special Issue*.
100. The duty to *protect* against risks of harm of science should not be confused with the duty to 'protect' human rights in general, referring to state duties to ensure that third parties do not interfere with the enjoyment of human rights. As elaborated on further below, the anticipation duty to protect against the risks of harm of science includes positive duties to 'protect' and to 'fulfil', as well as negative duties to 'respect'.
101. There is no obligation of course to protect against all minute risks of science and its applications as this would be unrealistic, overburden public institutions and ultimately stifle individual freedom.
102. See e.g. in the context of the right to life protected by the ECHR: ECtHR, *Osman v UK,* Judgment (Grand Chamber), No 23452/94, 28 October 1998, para.116; *Mastromatteo v Italy*, Judgment (Grand Chamber), No 37703/97, 24 October 2002, para.68; *Öneryildiz v Turkey*, Judgment (Grand Chamber), No 48939/99, 30 November 2004, para.101; and in the context of the right to privacy: ECtHR, *Koldayenko and Others v Russia*, Judgment (Chamber), No 17423/05 *et al.*, 28 Feb 2012, para.212.
103. See e.g. ECtHR, *Koldayenko and Others v Russia*, paras.162–6.
104. E.g. ECtHR, *Osman v UK*, para.116; *O'Keeffe v Ireland*, Judgment (Grand Chamber), No 35810/09, 28 January 2014, paras.144 and 162; *Öneryildiz v Turkey*, para.101.
105. It should be noted, however, that the CESCR in its General Comment 25 does not appear to build on these general standards of international human rights law. Instead, it refers to 'unacceptable harm' in para.56 which includes 'serious and effectively irreversible harm'. Overall, this standard appears to be informed by other bodies of international law, e.g. environmental law and biomedical law. Besson, 'Anticipation under the HRS', introduction to this *Special Issue*; Donders and Plozza, 'Look Before you Leap', in this *Special Issue*.
106. See also Donders and Plozza, 'Look Before you Leap', in this *Special Issue*, on the standard of due diligence and the HRS.
107. See e.g. *Explanatory Report to the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine*, ETS No 164, Oviedo 1997, sub 14, https://rm.coe.int/16800ccde5; also recognised in CESCR, General Comment 25, para.72.
108. Donders and Plozza, 'Look Before you Leap', in this *Special Issue*.
109. CESCR, General Comment 25, para.56.
110. Art.1 BWC and Art.1 Chemical Weapons Convention (CWC), adopted 3 September 1992, 1974 UNTS 45, entered into force 29 April 1997.
111. See e.g. Art.3 EU Fundamental Rights Charter; Arts.11 and 24 UNESCO Universal Declaration on the Human Genome and Human Rights (1997); Art.13 Oviedo Convention.
112. Art.7 ICCPR recognises that this amounts to torture or inhuman or degrading treatment, and thus causes severe physical or mental pain or suffering and thus harm to human beings.
113. CESCR, General Comment 25, paras.22 and 56.
114. Ibid., para.17; this duty is also prominent in ECtHR jurisprudence concerning anticipatory duties, see e.g. ECtHR, *Koldayenko and Others v Russia*, para.159; and *Vilnes and Others v Norway*, Judgment (Chamber), No 52806/10, 5 December 2013, paras.233–44.
115. CESCR, General Comment 25, paras.18-19 and 86–87; UNSR Report (2012) on HRS, paras.51, 53 and 74(n).
116. CESCR, General Comment 25, paras.45–46 and 87.

117. For an overview see e.g. Frederick Abbott and Graham Dukes, 'The Global Regulatory Environment', in *Global Pharmaceutical Policy: Ensuring Medicines for Tomorrow's World*, ed. Frederick Abbott and Graham Dukes (Edward Elgar, 2009), 86–115; CESCR, General Comment 25, para. 71.
118. Besson, 'Science without Borders', 479.
119. CESCR, General Comment 25, paras.74 and 81.
120. On the circularity and other dangers of an exclusively techno-scientific approach to anticipation duties in particular under the HRS see Besson, 'Anticipation under the HRS', introduction to this *Special Issue*.
121. CESCR, General Comment 25, para.42.
122. Ibid.
123. OHCHR, The Right to Privacy in the Digital Age, Report of the OHCHR, A/HRC/51/17, 22 August 2022, para.54.
124. Ibid.; of course, positive duties to prevent the foreseeable harm from materialising will also arise in this case.
125. CESCR, General Comment 25, paras.45, 52, 75, 84 and 89.
126. Ibid., para.87.
127. As with the prevention of harm, not every minute potential benefit from science can be promoted by states as a matter of the HRS.
128. CESCR, General Comment 25, paras.8, 14, 16, 46–47 and 86–87.
129. As indicated ibid., para.74.
130. Ibid., paras.52 and 73.
131. Ibid., para.70.
132. Ibid., para.47
133. Ibid., para.89.
134. Donders, 'In Search of State Obligations', 376.
135. CESCR, General Comment 25, para.42; Venice Statement, para.14(c); UNSR Report (2012) on HRS, paras.40–41.
136. CESCR, General Comment 25, paras.42 and 46; Venice Statement, para.14(a); UNSR Report (2012) on HRS, para.40; See also Beiter, 'Where are all the Freedoms Gone?', 248, highlighting that scientific and academic freedom should entail more robust speech rights than 'normal' freedom of expression because science thrives to reveal truth and new knowledge for the advancement of society, speaking out about which can expose scholars and scientists to undue attacks.
137. CESCR, General Comment 25, para.50; UNSR Report (2012) on HRS, para.40.
138. CESCR, General Comment 25, paras.43–44, on duties to 'protect'; Venice Statement, para.15(b). This includes corporations and international organisations.
139. CESCR, General Comment 25, para.46; UNSR Report (2012) on HRS, para.40; Venice Statement, para.14(c); Beiter, 'Where are all the Freedoms Gone?', 241–2.
140. CESCR, General Comment 25, para.87.
141. Ibid., paras.43 and 57.
142. See e.g. Venice Statement, para.16(c); CESCR, General Comment 25, para.57.
143. The high stringency of this duty is due to the fact that the right not to be subjected to non-consensual medical or scientific experimentation forms part of the right not to be subjected to torture or inhuman or degrading treatment (Art.7 ICCPR), an (absolute) right which can neither be limited nor derogated from. See also Donders, 'In Search of State Obligations', 377.
144. CESCR, General Comment 25, paras.19, 22, 33, 35, 40, 43 and 71; Venice Statement, para.15 (b); UNSR Report (2012) on HRS, paras.51–52; Art.16 Oviedo Convention; Art.24 Additional Protocol to the Convention on Human Rights and Biomedicine, concerning Biomedical Research, CETS No. 195, 2005; Art.6(2) UNESCO Universal Declaration on Bioethics and Human Rights (2005); OHCHR, UN Special Rapporteur on the Right to Health, Report on Informed Consent, A/64/272, 10 August 2010, para.35; see also Porsdman

Mann, Porsdman and Donders, 'Sleeping Beauty', 351; and Donders, 'In Search of Duties', 372–73 and 377.

145. Art. 5 Oviedo Convention; Art.6(2) UNESCO Declaration (2005); John Tasioulas and Effy Vayena, 'Getting Human Rights Right in Global Health', *The Lancet* 385, no.9978 (2015): 42, 42, referring to a human right not to participate in medical experiments.
146. Art.16(v) Oviedo Convention; UNSR on the Right to Health, Report on Informed Consent, para.35.
147. Art.7 ICCPR; see also: HRCttee, Concluding Observations – US, CCPR/C/USA/CO/3/Rev.1, 2006, para.33; HRCttee, Concluding Observations – Netherlands, CCPR/CO/72/NET, 2001, para.7.
148. Art.24 Additional Protocol to Oviedo Convention; UNSR on the Right to Health, Report on Informed Consent, para.35.
149. See e.g. Nuremberg Code (1947), principle 1; Art.5 Oviedo Convention and its Explanatory Report, para.35; Art.15(2) UNESCO Declaration (2005); UNSR on the Right to Health, Report on Informed Consent, para.36.
150. See e.g. Venice Statement, para.16(c).
151. As indicated in section 3 above.
152. CESCR, General Comment 25, paras.10, 24, 35, 45 and 65; see also Venice Statement, paras.12(b), 13(a), 16(a) and (e); UNSR Report (2012) on HRS, paras.43–44; and Porsdam Mann, Porsdam and Donders, 'Sleeping Beauty', 344.
153. CESCR, General Comment 25, paras.8, 21, 37, 54 and 87.
154. Ibid., paras.53–55.
155. Ibid., para.57.
156. Ibid., para. 81; Venice Statement, paras.12(g), 16(d) and 17; UNSR Report (2012) on HRS, para.8.
157. Besson, 'Science without Borders', 479–81.
158. CESCR, General Comment 25, paras.79–80; Venice Statement, paras.12(g) and 24; UNSR Report (2012) on HRS, para.67; see also Donders, 'In Search of Duties', 176.
159. CESCR, General Comment 25, para.84; Venice Statement, para.15.
160. CESCR, General Comment 25, para.84; CESCR, General Comment 24 – State Obligations in the Context of Business Activities, E/C.12/GC/24, 23 June 2017, paras.31–33; UNSR Report (2012) on HRS, paras.52 and 71. There are unfortunate examples of pharmaceutical corporations conducting clinical trials in low-income countries in disregard of informed consent and other ethical principles, see e.g. Jacob Levich, 'Disrupting Global Health: The Gates Foundation and the Vaccine Business', in *Routledge Handbook on the Politics of Global Health*, ed. Richard Parker and Jonathan Garcia (Routledge, 2018), 207, 213–4.
161. CESCR, General Comment 25, para.83; and as indicated in Art.61 Draft Articles on Responsibilities of International Organisations (DARIO), 2011.
162. Responsibilities discussed here shall not be confused with secondary (remedial) responsibilities that arise once (primary) human rights duties have been violated, in accordance with the Draft Articles on Responsibilities of States for Internationally Wrongful Acts (ARSIWA), 2001.
163. Besson, 'A Quiet (R)evolution', 262.
164. The literature therefore sometimes refers to them as 'secondary' or 'complementary' responsibilities ('obligations') as opposed to the 'primary' obligations of states of jurisdiction, see e.g. Margot Salomon, 'Deprivation, Causation and the Law of International Cooperation', in *Global Justice, State Duties*, ed. Langford *et al.* (CUP, 2011), 278–9; and Wouter Vandenhole and Wolfgang Benedek, 'Extraterritorial Human Rights Obligations and the North-South Divide', in *Global Justice, State Duties*, ed. Langford et al. (CUP, 2011), at 335.
165. But see CESCR, General Comment 25, para.49, highlighting that not only states but also individuals and entities like 'scientists, universities, publishers, scientific associations, funding agencies, libraries, the media and non-governmental institutions' should 'play a decisive role in the dissemination of knowledge' and thus at least they have responsibilities in regard to this element of the HRS. There is no reason why they should not also have

responsibilities for the other elements of the HRS, including protection from harmful/risky science and technology and the promotion of beneficial scientific research and its applications.

166. CESCR, General Comment 14, para.63.
167. See e.g. CESCR, General Comment 2 – International Technical Assistance Measures, contained in document E/1990/23, 1990, para.2; General Comment 11 – Plans of Action for Primary Education, E/C.12/1999/4, 11 May 1999, para.11; General Comment 12 – Right to Food, E/C.12/1999/5, 12 May 1999, para.30; General Comment 14, para.64.
168. See e.g. CESCR, Public Debt, Austerity Measures and the International Covenant on Economic, Social and Cultural Rights, Statement of the CESCR, E/C.12/2016/1, 22 July 2016, para.1.
169. E.g. CESCR, General Comment 21 – Right of Everyone to Take Part in Cultural Life, E/C.12/GC/21, 21 Dec 2009, para.73; General Comment 12, para.20; General Comment 14, para.42. See also OHCHR, Guiding Principles on Business and Human Rights, endorsed by the UN Human Rights Council, Resolution 17/6, A/HRC/RES/17/A, 6 July 2011, spelling out corporate responsibilities for human rights.
170. CESCR, General Comment 14, para.42; similarly, General Comment 12, para.20.
171. CESCR, General Comment 17, para.55.
172. CESCR, General Comment 15 – Right to Water, E/C.12/2002/11, 20 January 2002, para.60; General Comment 14, para.46.
173. E.g. Committee on the Rights of the Child (CRCttee), General Comment 5 – General Implementation Measures, CRC/GC/2003/5, 27 Nov 2003, para.64; CESCR, General Comment 15, para.60; General Comment 14, para.46; General Comment 21, para.73; General Comment 18 – Right to Work, E/C.12/GC/18, 6 Feb 2006, para.52; General Comment 24, para.5; and Guiding Principles on Business and Human Rights, Principle 11 and Commentary.
174. UN General Assembly, Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms, Res 53/144, 8 March 1999.
175. Ibid., Art.18(2).
176. David Miller, *National Responsibility and Global Justice* (OUP, 2007), 98 ff.
177. Besson, 'Science without Borders', 477 and 484; and Besson, 'A Quiet (R)evolution', 263–4.
178. See also Arts.11(1) and (2) and 23 ICESCR; and Art.4 CRC.
179. ICJ, *Interpretation of the Agreement of March 1951 between the WHO and Egypt*, Advisory Opinion, ICJ Reports (1980) 73, para.37; see also Arts.2(b) and 10 of the Draft Articles on the Responsibilities of International Organisations (DARIO) (2011) and commentary, p.63; and relevant academic literature, e.g. Gerhard Hafner, 'Accountability of International Organisations – A Critical View', in *Towards World Constitutionalism*, ed. Ronald St John MacDonald and Douglas Johnston (Nijhoff, 2005) 585, 629; August Reinisch, 'Governance Without Accountability?', *German Yearbook of International Law* 44 (2001): 207, 281–2.
180. Preamble, Constitution of the World Health Organization (WHOC), 14 UNTS 185, entered into force 7 April 1948; Art.3(2) IHR 2005, also cross-refers to WHOC. International organisations are bound by their constituent instrument, even if they are not parties to this instrument (see: ICJ, *Reparations for Injuries Suffered in the Service of the United Nations*, Advisory Opinion, ICJ Reports (1949) 174, para.180).
181. Art.3(1) IHR.
182. Whilst there is analysis of customary IHRL addressing states (e.g. William Schabas, *The Customary Law of Human Rights* (OUP, 2021)), to the author's knowledge, no systematic studies on the possible customary nature of responsibilities for human rights or international organisations, let alone other non-state responsibility-bearers, have been conducted so far.
183. See e.g. CRCttee, General Comment 16 on State Obligations Regarding the Impact of the Business Sector on Children's Rights, CRC/C/GC/16, 13 April 2013, referring to 'practice'

in its para.8: ' […] the Committee recognizes that […] responsibilities to respect the rights of children extend *in practice* beyond the State and State-controlled services and institutions and apply to private actors and business enterprises. Therefore, all businesses must meet their responsibilities regarding children's rights […] ' (my emphasis). Whose 'practice' is of relevance here is, however, unclear, as is the need as to whether evidence of *opinio iuris* is also required to establish customary IHRL establishing responsibilities for human rights of non-state responsibility-bearers.

184. Maastricht Centre for Human Rights/International Commission of Jurists, Maastricht Principles on Extraterritorial Obligations of States in the Area of Economic, Social and Cultural Rights, 28 Sept 2011, https://icj2.wpenginepowered.com/wp-content/uploads/2012/05/Maastricht-Principles-analysis-brief-2011.pdf.
185. E.g. Guiding Principles on Business and Human Rights, 2011; Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society, 1999; UNGA, Declaration on the Right to Development, A/RES/41/128, 4 Dec 1986; OHCHR, Human Rights Guidelines for Pharmaceutical Companies in Relation to Access to Medicines, published in the report of the UN Special Rapporteur on the Right to Health, A/63/263, 11 August 2008. For an overview of additional documents, see Margot Salomon, *Global Responsibility for Human Rights – World Poverty and the Development of International Law* (OUP, 2007), 92–8.
186. Besson, 'Science without Borders', 484; and Besson, 'A Quiet (R)evolution', 263–46.
187. The need for institutions to implement the HRS is widely recognised in the literature. But there is usually little detail as to how these institutions are to be shaped, operate, cooperate, control each other etc. See e.g. Venice Statement, para.16(a); or Donders, 'In Search of Duties', 379. An exception is of course Besson, 'Science without Borders'.
188. CESCR, General Comment 3 – Nature of State Parties Obligations, contained in document E/1991/23, 14 Dec 1991, para.8. Similarly, see HRCttee, General Comment 25, para.1.
189. E.g. ECtHR, *Ždanoka v. Latvia*, Judgment (Chamber), No 58278/00, 16 March 2006, para.98; *Refah Partisi (the Welfare Party) and Others v. Turkey,* Judgment (Grand Chamber), No 41340/98, 13 Feb 2003, para.86; *Navalnyy v. Russia,* Judgment (Chamber), No 29580/12, 15 Nov 2018, para.175.
190. Art.25(b) ICCPR; Art.3 P-I to ECHR.
191. Arts 2(3) and 14(1) ICCPR; Arts.6(1) and 10(2) ECHR.
192. E.g. ECtHR, *Van de Hurk v the Netherlands*, No 16034/90, 19 April 1994, paras.44–55; *Animal Defenders International v. UK,* No 48876/08, 22 April 2013.
193. Art.25(b) ICCPR; HRCttee, General Comment 25, paras.7, 10–12, 19 and 21.
194. HRCttee, General Comment 25, para.25; also, ECtHR, *Refah Partisi v Turkey,* para.89.
195. Art 2(3) ICCPR; HRCttee, General Comment 31 – Nature of the General Legal Obligation Imposed on State Parties to the Covenant, CCPR/C/21/Rev.1/Add.13, 26 May 2004, para.15; HRCttee, General Comment 25, para.20; Arts.6 and 13 ECHR.
196. See e.g. Report of the UNSR on Extreme Poverty (2018), paras.67–70 and 85–86.
197. CESCR, General Comment 25, para.86–87; UNSR Report (2012) on HRS, para.52; see also Chapman, 'Towards an Understanding', 21.
198. CESCR, General Comment 25, paras.49 and 87; UNSR Report (2012) on HRS, paras.43 and 74(d).
199. CESCR, General Comment 25, paras.43, 47 and 49; UNSR Report (2012) on HRS, paras.72 and 74(d).
200. See e.g. Arts.6(1), 8(c)(i), (ii), 9(1), 12(1) and (3), 13, 14(1), 15 (concerning criminal law), 17 (1) and (2), 18(3), 19(3), 20, 21 and 22(2) ICCPR; Arts.4 and 8(1)(a), (c) ICESCR; and Arts.2, 5(1), (2) and (4), 6(1) and 8(2)-11(2) ECHR. On the legality standard see also Harris *et al.* (eds), *The Law of the ECHR* (OUP, 2018), 20–22; and HRCttee, General Comment 36 – The Right to Life, CCPR/C/CG/36, 18 Oct 2018, with numerous examples of legislative measures that states should adopt to protect the right to life.
201. On the approach of the ECtHR evaluating parliamentary engagement, see Matthew Saul, 'The European Courts of Human Rights' Margin of Appreciation and the Process of National Parliaments', *Human Rights Law Review* 15, no. 4 (2015): 745.

202. See the argument by Boyle, 'Biowarfare and Terrorism', 16–18, 69 and 71–74.
203. Besson, 'Science without Borders', 479–80.
204. Implementation and Support Unit: https://www.un.org/disarmament/biological-weapons/implementation-support-unit
205. See sources listed in *supra* notes 12 and 46. And Gert Meeus *et al.*, 'Efficacy and Safety of In-hospital Treatment of Covid-19 Infection with Low-dose Hydroxychloroquine and Azithromycin in Hospitalized Patients: A Retrospective Controlled Cohort Study', *New Microbes and New Infections* 55 (2023): 101172.
206. The low risk of these early treatment protocols is clear *inter alia* due to the fact that the drugs included – e.g. Ivermectin and Hydroxychloroquine – are part of WHO's list of essential medicines, see WHO, Model List of Essential Medicines, 22nd List (2021), at https://www.who.int/publications/i/item/WHO-MHP-HPS-EML-2021.02
207. CESCR, General Comment 25, para.57.
208. Venice Statement, paras.12 (f) and 16 (c); CESCR, General Comment 25, para.56; UNSR Report (2012) on HRS, para.50.
209. See e.g. Peter Doshi, Fiona Godlee and Kamran Abbasi, 'Covid-19 Vaccines and Treatments: We Must Have Raw Data, Now', *British Medical Journal* 376 (2022): o102, noting that there are numerous legal and practical hurdles to access the raw data of *Pfizer's* and *Moderna's* clinical trials with Covid-19 vaccines. Therefore, in the current system, a thorough and fully transparent scrutiny and debate of the harm and risks involved appears impossible. See also more generally, Peter Doshi *et al.*, 'Restoring Invisible and Abandoned Trials: A Call for People to Publish the Findings', *British Medical Journal* 346 (2013): f2865.
210. WHO, Emergency Use Listing Procedure, 9 August 2022, 11–14.
211. See CHMP's website: https://www.ema.europe.eu/en/committees/committee-medicinal-products-human-use-chmp.
212. See statements of the WHO-Covid-19-EC listed in *supra* note 42.
213. See e.g. WHO-Covid-19-EC, Statement on the Fifth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 30 Oct 2020, rec.8 to state parties; Statement on the Ninth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 26 Oct 2021, rec.9 to state parties; Statement on the Tenth Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 19 Jan 2022, rec.9 to state parties; and Statement on the Eleventh Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Coronavirus Disease (COVID-19) Pandemic, 13 April 2022, rec.9 to state parties. All statements available at: https://www.who.int/covid-19-ihr-emergency-committee.
214. See the discussion in section 2 above.
215. This is important also in context of judicial decision-making on the HRS. See section 5.1 c) below. On that danger see also Besson, 'Anticipation under the HRS', introduction to this *Special Issue.*
216. Doshi, Godlee and Abbasi, 'We Must Have Raw Data, Now'.
217. See Josh Guetzkov, 'CDC Admits it Never Monitored VEARS for COVID Vaccine Safety Signal', The Defender, 21 June 2022, https://childrenshealthdefense.org/defender/cdc-vares-vocid-vaccine-safety/.
218. Of course, such engagement in the communal process of science protected by the HRS by the medical profession is limited and shaped not only by domestic legislation but also by ethical standards, including professional ethical codes like the Hippocratic Oath. The Hippocratic Oath can be seen as an example of the self-regulatory instruments adopted by a specific epistemic community to ensure that (risks of) harm of medical research, science and treatment are prevented, monitored or otherwise controlled.
219. CESCR, General Comment 25, paras.84 and 89.
220. The number of states that ratified the Optional Protocol to the ICESCR remains low at 26 (as of 30 December 2022).

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231. See e.g. Report of the UNSR on Extreme Poverty (2018), paras.70 and 84–86; see also Melissa Durkee, 'International Lobbying Law', *The Yale Law Journal* 127 (2018): 1742.
232. See ibid., for an overview of these privatisation processes that also systematically undermine states' ability to secure human rights.
233. To name just two examples, see the role of Jeremy Farrar as director of the *Wellcome Trust*, member of the Trust's internal investment committee, as member of the Scientific Advisory Group for Emergencies advising the UK government on Covid-19, as board member of *Cepi* (see Schwab, 'Covid-19, Trust, and Wellcome') and most recently, his appointment as Chief Scientist of WHO (see: https://www.who.int/news/item/13-12-2022-world-health-organization-names-sir-jeremy-farrar-as-chief-scientist-dr-amelia-latu-afuhaamango-tuipulotu-as-chief-nursing-officer); and Emer Cook, currently Head of EMA, who has been working for the European Federation of Pharmaceutical Industries and Associations (EFPIA), the

biggest lobby organization of big European pharmaceutical corporations before (see: https://www.ema.europa.eu/en/about-us/who-we-are/executive-director).

234. See e.g. EMA Policy on Handling of Competing Interests of Scientific Committees' Members and Experts, EMA/MB/89351/2020, 1 June 2020.
235. Among them through the judiciary's ability to make binding decisions that cannot be set aside by a non-judicial entity as well as the requirement that judicial decisions must indeed be executed. Independence is also guaranteed through appropriate appointment procedures for judges ensuring their integrity, training, appropriate renumeration and tenure. See also, Basic Principles on the Independence of the Judiciary, adopted by the Seventh UN Congress on the Prevention of Crime and the Treatment of Offenders held at Milan from 26 August to 6 September 1985 and endorsed by UNGA Res 40/32, 29 Nov 1985, and UNGA Res 40/146, 13 Dec 1985.
236. CESCR, General Comment 25, para.81.
237. Art.1(1) BWC reads: 'Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain: (1) microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes; […] '.
238. BWC Implementation Support Unit, https://disarmament.unoda.org/biological-weapons/implementation-support-unit.
239. Art.8(1) CWC.
240. Besson, 'Science without Borders', 480.
241. Art.2 WHOC.
242. See *supra* notes 180–2.
243. Arts.10–23 WHOC on the role of the WHA.
244. See e.g. the decision of the WHO Director-General to declare the outbreak of monkeypox a PHEIC in July 2022, against the advice of the majority of the members of the emergency committee: WHO Monkeypox-EC, Statement on the Second Meeting of the International Health Regulations (2005) Emergency Committee Regarding the Multi-Country Outbreak of Monkeypox, 23 July 2022, https://www.who.int/news/item/23-07-2022-second-meeting-of-the-international-health-regulations-(2005)-(ihr)-emergency-committee-regarding-the-multi-country-outbreak-of-monkeypox.
245. Arts.48 and 49 IHR. It should be noted that most WHO global policies and recommendations are elaborated by expert committees.
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248. Ibid., 7.
249. The original promise of the 95% effectiveness of the vaccines given by the manufacturers in late 2020 have not been confirmed (see *supra* notes 50 and 51).
250. It does not appear that such powers are among either TAG-EUL's (WHO, Emergency Use Listing Procedure, 9 August 2022) or SAGE's powers (SAGE's terms of reference, at: https://cdn.who.int/media/docs/default-source/immunization/sage/tors_sage_june2022.pdf).
251. Strategic Advisory Group of Experts on Immunization (SAGE) website: https://www.who.int/groups/strategic-advisory-group-of-experts-on-immunization/.
252. WHO's website on Covid-19 vaccine safety makes the following general statement on safety monitoring of EUL vaccines: 'After a COVID-19 vaccine is introduced, WHO supports work with vaccine manufacturers, health officials in each country and other partners to monitor for any safety concerns on an ongoing basis' (at: https://www.who.int/news-room/feature-stories/detail/safety-of-covid-19-vaccines).
253. WHO's Global Advisory Committee on Vaccine Safety (GACVS) terms of reference do not describe such thresholds (see: https://www.who.int/media/docs/default-source/pvg/global-vaccine-safety/gacvs-tor-170619.pdf). However, it appears that GACVS runs pilot projects

on using AI to identify adverse events in relation to Covid-19 vaccines, see: GACVS, COVID-19 Vaccine-related Events Early Warning System, Report, 23 July 2021, https://www.who.int/groups/global-advisory-committee-on-vaccine-safety/topics/covid-19-vaccines/early-warning-system. Moreover, GACVS has issued a number of statements informing about adverse events following vaccination with investigational Covid-19 vaccines (see: https://www.who.int/groups/global-advisory-committee-on-vaccine-safety/).

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Anticipation and diplomacy (with)in science: activating the right to science for science diplomacy

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ABSTRACT

How can scientists assist society and contribute to international policymaking – and just as crucially, how can society engage with and shape science? What will it take to make modern science diplomacy for the Anthropocene successful so that the benefits of science are furthered and its risks and harms, as far as possible, prevented?

In this article, we explore the relevance and usefulness of three areas of study to these questions: science diplomacy, the human right to science, and anticipation in the context of scientific and technological developments. We argue that a hitherto underappreciated aspect of science diplomacy – diplomacy (with)in science – has significant potential to complement anticipatory approaches such as the Geneva Science and Diplomacy Anticipator's (GESDA's) by furthering the same goals: ameliorating the negative impacts of scientific and technological developments and facilitating their benefits. We relate the concept of diplomacy (with)in science to the normative framework of the right to science under international human rights law and develop and motivate it further by illustrating two potential areas for its application.

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Nothing anticipates the risks and benefits of science and technology quite as intriguingly as science fiction – especially when it is done as expertly as in *The Ministry for the Future* by Kim Stanley Robinson.[1] Set in the near-future, the novel interweaves factual details of global warming with fictional stories of the scientists, economists, and diplomats who attempt to overcome the extraordinary challenges humanity faces in the Anthropocene. As it opens, 'it is getting hotter.'[2] At the 29th Conference of the Parties (COP) to the Paris Agreement Under the United Nations Framework Convention on Climate Change in 2023, delegates react by creating a new agency or subsidiary body with permanent duties to be placed in Zurich, Switzerland. They task this agency, nicknamed 'the Ministry for the Future' by members of the press, with representing the interests of future generations 'whose rights, as defined in the Universal Declaration of Human Rights,

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are as valid as our own' and with promoting the legal standing and physical protection of 'all living creatures present and future who cannot speak for themselves.'[3]

The new Ministry is headed by Irish lawyer and diplomat Mary Murphy and staffed with scientists, economists, lawyers, and political scientists – or what Robinson calls 'scientific politicians' and 'politicized scientists.'[4] From the very beginning, the 'nat cat' (natural catastrophes) group offers a 'flood of suggestions'; indeed, 'you could literally fill a medium-sized encyclopedia with the good new projects already invented and waiting to scale.'[5] These projects span from carbon-negative agriculture, direct air capture of CO2, landscape restoration and habitat corridors to a new kind of currency, blockchained carbon coins, as well as open source instruments that protect people's private data by using quantum encryption.

The scientific inventions and technology are there, available to be used at a moment's notice, but it takes all the (science) diplomacy Mary and her staff can muster to get the attention of the world's politicians, bankers, and financiers. In the end, however, they are successful beyond their wildest hopes. When Mary is about to retire, she participates in the 58th COP meeting of the Paris Agreement signatories in 2053. At this point, as she proudly observes, many of her staff's suggestions have been carried out in practice, and the worst climate change catastrophes have been averted.

Robinson has the two COP meetings – COP 29 and COP 58 – bookend *The Ministry for the Future*. What is especially interesting for our purposes is his belief in the rule of law and human rights, and in the U.N. system as a necessary framework for science in the service of the global public good – that is, for the scientific and technological progress needed to counter climate change for the benefit of everyone.[6]

In terms of genre, *The Ministry for the Future* is clearly closer to a utopian than to a dystopian scifi novel. It may be a stretch to label it a science diplomacy novel, but the questions asked and attempted answered by Robinson bear a striking resemblance to the ones we would like to discuss in this article: How can scientists assist society and contribute to international policymaking – and just as crucially, how can society engage with and shape science? What will it take to make modern science diplomacy for the Anthropocene successful so that the benefits of science are furthered and its risks and harms, as far as possible, prevented?

In what follows, we explore the relevance and usefulness of three areas of study to these questions: science diplomacy, the human right to science, and anticipation in the context of scientific and technological developments. In this context, 'anticipation' embodies the imperative to foresee and control potential harms by identifying risks, managing and containing them, and even holding entities accountable for not doing so. With the surge of dual-use technologies and scientific practices that can both benefit and potentially harm humanity, the necessity to anticipate not just the risks but also the opportunities presented by science has grown significantly.

Science diplomacy refers to a set of practices and areas of academic study concerned with the use and exchange of science and technology for purposes which may include, but are broader than, scientific discovery.[7] Though interactions between science, scientists, diplomats, and diplomacy have long taken place, science diplomacy as an area of academic interest is a relatively recent field. Unlike traditional diplomacy, science diplomacy practitioners may or may not be agents of the state, with contributors ranging from science advisors to diplomats and scholars.[8] As a result, 'science diplomacy' is an

umbrella term used to refer to various intersections between science, policy, and international relations,[9] areas which greatly impact one another.[10]

One aspect of science diplomacy focuses on the role of science and scientists in furthering national or cross-border interests.[11] What especially concerns us in this article is a second aspect of science diplomacy, namely the use and exchange of science and scientists to address issues that are international or global in scope.[12] Given the global impact of modern science and technology, many areas of contemporary science diplomacy seek to address issues in which science, technology, and scientists themselves play crucial roles. Climate change and global public health are good examples of this. As Peter Gluckman points out, attempts such as those by the Geneva Science and Diplomacy Anticipator (GESDA) to anticipate societal, including geopolitical, impacts of developments in science and technology are especially relevant to this sense of science diplomacy.[13]

We argue that a hitherto underappreciated aspect of science diplomacy – diplomacy (with)in science – has significant potential to complement anticipatory approaches such as GESDA's by furthering the same goals: ameliorating the negative impacts of scientific and technological developments and facilitating their benefits. In Section I below, we provide an overview of science diplomacy and develop our notion of diplomacy (with)in science. Section II relates diplomacy (with)in science to the normative framework of the human right to science, as outlined in both Article 27 in the 1948 Universal Declaration of Human Rights (UDHR) and Article 15 of the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR).

In the final Section III, we provide two case studies exemplifying how a right to science-based diplomacy (with)in science may complement the goals of anticipation. One of these concerns blockchain and decentralised science, which arguably facilitate participation in scientific processes and ensure that rights- and stakeholders are heard in practice. The other discusses the requirement of Article 4 ICESCR that the common good be taken into account in decision-making concerning science, its development and diffusion, and its applications.

Throughout, excerpts from Robinson's *The Ministry for the Future* will help us introduce and touch upon issues of special relevance.

Science diplomacy: as open as possible, as closed as necessary

The kind of science diplomacy that Mary and her team at the Ministry for the Future engage in is not new. The British Royal Society, for example, employed an 'Assistant to the Secretaries for Foreign Correspondence' as early as 1723,[14] and science as a valued part of cultural exchange dates to antiquity.[15]

During the twentieth century, scientists became increasingly involved in political and diplomatic matters and research outcomes, but also science itself as a process and way of communicating was used to further specific power interests.[16] One prominent and outspoken twentieth-century scientist to realise that the tools, techniques and tactics of foreign policy need to adapt to a world of increasing scientific and technical complexity was the Danish physicist and Nobel Prize winner Niels Bohr.[17] The only way to curtail the post-war nuclear danger and to maximise benefits from recent scientific and technological breakthroughs, he argued, was to share science and technology across both geographical and academic borders.[18] With increasing tensions between the U.S. and China

and the recent outbreak of war in the Ukraine, Bohr's ideas are as timely as ever. As a prerequisite for peace, openness needs, as Bohr saw it, to be promoted and scientists can and should play a part in this process.

In the twenty-first century, several of the defining challenges – from climate change and global pandemics such as COVID-19 to food security, poverty reduction, and nuclear disarmament – have scientific dimensions. As recognised in a recent German government Strategy Paper, these challenges call for 'international responses.'[19] This means that even issues normally considered to belong within a foreign and security policy framework must now 'be examined under the microscope of international scientific discourse and subjected to any criticisms that may result.'[20] For these and other reasons, the EU wants to play an increasingly active and visible role in international science diplomacy.[21] The European Commission has made open access to research data applicable by default in European funding schemes but has also recognised that there may be good reasons to keep certain research results closed. Encouraging sound research and data management means finding the right balance between 'as open as possible' and 'as closed as necessary.'[22]

Recent UN instruments, originating from different UN bodies – the 2030 Agenda on Sustainable Development, the 2017 UNESCO Recommendation on Science and Scientific Researchers, and the CESCR's 2020 General Comment No. 25 on Science – recognise the important role of scientists in helping to lay the foundation for a peaceful and sustainable world. According to the latter two of these instruments, scientists can do so by collaborating broadly with citizen scientists and colleagues in other fields; engaging with legislators and policymakers to help base policies on evidence; as well as by paying due regard to the intellectual autonomy of scientists, their scientific freedom, and the ethical implications of their research.[23]

This is a tall order. For many scientists, the most essential thing is to carry on with their research – and avoid being sidetracked by or 'wasting time' on non-scientific issues. Yet, as Niels Bohr and other scientists attempted to show regarding the nuclear revolution in the mid-twentieth century, the best prerequisite for overcoming political mistrust is a sense of shared urgency to solve critical global issues. As another Nobel laureate, biochemist Jennifer Doudna, wrote in 2020 about the decision of the Trump administration to pull funding and membership from the WHO during the COVID crisis, when governments refuse to help, or when they interfere in a negative way as the Trump administration had just done, scientists must 'rely on a renewed push for 'science diplomacy' … [to] champion education and evidence-based decisions with greater public buy-in and lower political friction.'[24]

Science diplomacy models: strengthening science from within

In the most often used and referenced science diplomacy models, this perspective from within or on behalf of science is missing. Collaborating with the American Association for the Advancement of Science (AAAS), the British Royal Society in 2010 suggested the following taxonomy, for example, which identifies three pillars of science diplomacy:

- Science in diplomacy: informing foreign policy objectives with scientific advice
- Science for diplomacy: using science cooperation to improve international relations between countries

- Diplomacy for science: facilitating international science cooperation.[25]

We suggest that a fourth pillar be added to this influential model: diplomacy (with)in science. 'In today's international order, nobody really speaks up for the global knowledge commons,' write Jean-Claude Burgelman and Luk Van Langenhove. 'That is precisely what scientists could do: play the role of being the diplomatic spokespersons of the global knowledge commons. This implies that science could be a diplomatic actor on its own behalf.'[26]

Burgelman and Van Langenhove call this use of advocacy for global scientific knowledge 'diplomacy in science' or 'knowledge diplomacy.' Instead of representing the interests of a state, diplomacy *in* science seeks to represent the interests of science by engaging with stakeholders who are not themselves scientists, but whose support is crucial for scientific progress, such as politicians, civil servants, and the public. This might take the form of lobbying, of educational campaigns, or of establishing international networks.

In addition to this outward focus – the engagement with stakeholders outside of science – diplomacy (with)in science, as we conceive it, also has an internal dimension. In diplomacy *within* science, attempts are made by both scientists and others to further scientific progress and other interests of science by engaging with actors, institutions, or processes within science. One example of this internally focused diplomacy (with)in science is the effort to promote scientific progress by increasing collaboration across scientific fields. As Gluckman puts it,

> [I]t is becoming clearer that we need to find new ways of doing science, such as employing transdisciplinary approaches – this itself is an internal form of diplomacy within science. […] Disciplinary silos need to be replaced by transdisciplinary approaches. The global and indeed national good needs the humanities, social sciences, data, health and natural sciences and technologies to cooperate. Important values are at stake, futures are at stake and science diplomacy of a new kind within ourselves will be needed too.[27]

The 2017 UNESCO Recommendation also suggests the incorporation of inter-disciplinary courses into the education and training of scientific researchers, with a view towards helping them develop their skill in 'isolating the civic and ethical implications, in issues involving the search for new knowledge and which may at first sight seem to be of a technical nature only.'[28] Detecting likely consequences, especially dangerous ones, and advocating for scientific integrity within science itself means employing a transdisciplinary approach and methodology involving the humanities and social sciences in addition to the natural and technological sciences.

Other examples might include initiatives designed to facilitate scientific progress by increasing access to participation in science among groups underrepresented in science; programmes aimed at fixing known or under-researched problems and challenges in science, such as pressures and biases of the kind that have led to the reproducibility crisis;[29] and the development of programmes that increase access to scientific knowledge, data, and equipment, such as the Open Science movement.[30]

Facilitating diplomacy (with)in science will require efforts at securing the support of domestic policies that strengthen scientific culture. A cornerstone of this effort is the nurturing and enhancement of public trust in science. In an era where misinformation is

rampant, trust in scientific findings and processes becomes paramount. This trust is not merely about accepting scientific results but involves understanding the rigorous methodology behind them and feeling science and scientists are working on topics and using methods that are important and acceptable to the public, even if not always straightforwardly so. By treating public funding of research and development as a form of public investment and emphasising the ethical dimensions of science and research – as noted in the 2017 UNESCO Recommendation on Science and Scientific Researchers – we can bolster this trust and ensure a more harmonious relationship between science and society.

Once soundly integrated at the national policy-making level, scientific and technological knowledge may then be used to further 'policies for international relations' and for strengthening 'capacities for science diplomacy.'[31]

When it comes to practical implementation, national academies of science could play a key role. Many are already engaged in policy work concerning science, and they are well positioned to feed into State reporting both for the Human Rights Council's Universal Periodic Review (UPR)[32] and for the monitoring of the implementation of the 2017 UNESCO Recommendation. A more active role for national academies of science in national reporting could be an example of potentially game-changing participation or lobbying, as science is one of the areas to which Member States collectively have paid the least attention in their reporting.[33] The UNESCO monitoring procedure may help raise awareness and promote international exchange, and the UPR provide platforms with yet untapped opportunities for holding Member States accountable for their obligations to ensure an enabling working environment for scientific researchers and for furthering science as a public good, and this may eventually prove to be important to help anticipate and prevent risky science.[34]

While the potential merits of diplomacy within science seem obvious, concerns might be raised about the politicisation of science and the possibility that diplomatic agendas might overshadow the interests of scientific inquiry. However, it is essential to point out that diplomacy within science as we envision it here aims to bridge the gap between science and policy-making, ensuring that scientific advancements are used for the collective good. It does not intend to compromise the integrity of scientific research. Nevertheless, the benefits of science diplomacy more generally will necessarily be contingent on a well-structured diplomatic approach aimed at keeping the emphasis on the 'science' aspect of 'science diplomacy'.

An important part of this new kind of science diplomacy thus evolves around scientific freedom and its limits. Freedom to conduct science, to exchange information, personnel, methods, and data, is a key scientific interest. If the safe exchange of scientists, scientific knowledge, and technological equipment cannot be guaranteed, no scientific progress can be made from which the public may benefit.[35] Thus, promoting the freedom of science from political, commercial, and other interference is an important task for diplomacy *in* science, that is, the external dimension of diplomacy (with)in science. But to ensure that such freedom does indeed further methodologically and ethically sound science, certain restrictions are necessary. While some of these are externally imposed, others have to do with scientific responsibility (as the alternate side of scientific freedom), and concern diplomacy *within* science.

The right to science and scientific freedom under responsibility

Among the scientific solutions that turn out to work well in *The Ministry for the Future* is pumping seawater out from under the big glaciers and back onto the rock beds to slow down global warming. Before they can dedicate themselves fully to this, however, the glaciologists working in Antarctica must take a scientific detour – for funding reasons. Instead of doing what they know will work scientifically, they 'had been following the money, taking it where we could get it and doing what they asked us to do with it.' As this produces no useful results, the glaciologists know that from now on, they must let their science lead them in order to 'give expert advice, [and] guide the money where it needed to go.'[36]

'The freedom indispensable for scientific research and creative activity' that is jeopardised for Robinson's glaciologists by following the money is protected under Article 15 (3) ICESCR. Without academic and scientific freedom, as former UN Special Rapporteur David Kaye puts it, 'societies lose one of the essential elements of democratic self-governance: the capacity for self-reflection, for knowledge generation and for a constant search for improvements of people's lives and social conditions.'[37]

Scientific responsibility as diplomacy in science

Article 15 ICESCR contains three additional provisions concerning science and culture; collectively, these four provisions constitute what is known as the right to science. As we have argued elsewhere, the connection between these provisions is best understood by reading the article from the bottom up.[38] Since the progress of science crucially relies on the exchange of ideas and observations, Article 15(4) recognises the importance of international scientific cooperation and freedom of movement. These complement, and are necessary for, scientific freedom more broadly (Article 15(3)), which in turn is required to produce the kind of progress in science and application that is to be disseminated (Article 15(2)) for the benefit of everyone (Article 15(1)).

In a democratic society, scientific research can never be entirely free, however, but must always be conducted in a socially and ethically responsible manner.[39] Scientific research and its products should be assessed not only on their scientific, but also on their human rights merits. To safeguard basic human rights principles such as human dignity and non-discrimination, various kinds of protection from *inter alia* dual-use research are needed. In the 2017 UNESCO Recommendation and the 2020 General Comment on Science as in other human rights instruments, necessary restrictions on scientific freedom therefore play a prominent role.

The ICESCR itself lays out its general criteria for limitations in its fourth Article. To be acceptable, such limitations must be 'determined by law and only in so far as this may be compatible with the nature of these rights and solely for the purpose of promoting the general welfare in a democratic society.' Thus, limitations must have been adopted by due legislative process; have a legitimate aim; and the limitation must be appropriate and proportionate to achieve this aim. In the context of the right to science, specific restrictions on research and application can be legitimate where necessary to prevent disproportionate or unnecessary harm or disrespect for other human rights.[40] The limitation criteria inherent in the ICESCR treaty system represent a careful balancing of

the interests of science and society which places a significant burden on those wishing to restrict scientific interests. As we shall see later, it provides a potentially powerful normative standard to which science diplomats can hold states accountable.

Specific measures that pass this high bar for legitimate restrictions on scientific freedom may include those aimed at ensuring confidentiality of data, and free, prior, and informed consent by specific populations such as indigenous populations or ethnic minorities.[41] Issues of prior consent and the protection, in general, of these groups are often linked to the democratic access to participate in science policy. This is an important aspect of citizen science, as Farida Shaheed pointed out in her 2012 report on the right to enjoy the benefits of scientific progress and its applications. The hope is that citizen participation in science and science policy may highlight the 'human factor' – that is, may help ensure focus on human dignity and integrity, thereby preventing dual-use science.[42] Forming part of the science-society interface and democratic dialogue underlined in the 2017 Recommendation, citizen participation can help further the interests of science directly, by increasing the amount of labour available for scientific projects. Perhaps more importantly, it can also do so indirectly, both by injecting an element of the wisdom of crowds into the design and conduct of science, as well as by increasing familiarity with and trust in science among the participating public.

Whereas Article 15(3) ICESCR promotes scientific progress by mandating the necessary freedom, Article 15(2) ICESCR does the same by more directly mandating steps towards 'the conservation, the development and the diffusion of science and culture.' The existence of this obligation on States parties to the ICESCR is of great relevance to science diplomats, who may draw attention to it, and legitimacy from it, in their efforts to promote the interests of science. Since Article 15(2) ICECSR is a voluntarily assumed obligation binding under international law to foster, maintain, and spread science, it represents a standard to which those acting on behalf of the interests of science can hold states accountable across the scientific pipeline from education and research through publications, conferences, and other products and exchanges.[43]

Both Article 15,2 and Article 15,3 ICESCR concern the obligations that States have to respect, protect, and fulfil the right of everyone to enjoy the benefits of scientific progress. To these should be added the issue of the responsibility of the individual researcher. This issue is raised in both the Special Rapporteur's report and the 2017 UNESCO Recommendation on Science and Scientific Researchers.

Scientific responsibility as diplomacy within science

The need to protect the public from harmful effects of science, scientific applications, and scientific misconduct introduces tensions to the principle of scientific freedom recognised in Article 15(3) ICESCR. Left unrestrained, powerful incentives, errors, and biases could well lead to neglect of human subjects' rights and interests in priority-setting and experimentation, insufficient attention to dual-use potential, and misleading, mercenary, or even fraudulent scientific claims. Consequently, various bodies have been issuing guidance on scientific responsibility and misconduct for decades.[44]

Other than the responsibility that scientists bear towards individuals and society, restrictions on scientific freedom also arise from responsibilities owed towards science itself. Scientific progress relies crucially on scientific integrity. Without it, minute

details and precise data must be scrutinised; even if colleagues have the time and skills to do so, this lack of trust in integrity necessarily introduces delays and uncertainties into the scientific process. Although innovations are needed to further progress, the underlying methodology must remain scientifically appropriate. Thus, forgeries, misrepresentations, fraudulently obtained consent, misleading figures, statistical hacks, questionable assumptions, etc. constitute significant threats to scientific progress.[45] For these reasons, such practices are cause for scientific excommunication if discovered:

> Scientific responsibility includes the responsibilities of scientists towards science and their fellow scientists – doing good science requires, for example, appropriate application of scientific methods, accurate reporting of results, and open dissemination of findings. It is now widely accepted that scientific responsibility extends beyond this and requires some consideration be given to the outcomes and consequences of research. Interpretation and determination of such responsibilities is frequently based on moral considerations.
>
> In relation to the public and decision-makers who influence the direction and application of science and technology – the scientific community has responsibilities because it is in a unique position to present information and knowledge that it is developing about the challenges which face humanity and how they might be addressed.[46]

Given the importance of scientific integrity to both science and society, several initiatives to promote this integrity exist. These include guidelines and procedures,[47] calls for, and instances of, scientific self-regulation,[48] as well as suggestions for an oath-based system of the kind currently used by various professions.[49]

The General Comment on Science adds to these approaches the view that, ultimately, significant issues at the science-society interface should be decided via democratic decision-making:

> In controversial cases, participation and transparency become crucial because the risks and potentials of some technical advances or some scientific researches should be made public in order that society, through an informed, transparent and participatory process, can decide whether or not the risks are acceptable.[50]

However, as a limitation on scientific freedom, any such mechanism for participation 'implies a strict burden of justification by States, in order to avoid infringing freedom of research.'[51] Here, as elsewhere in the Comment, we see in the interactions between Article 15's four parts a nuanced and useful tool for recognising and weighing the many interests at play in decision-making that has the potential to affect us all. Allowing the various rights- and stakeholders to be heard marks an important step toward making modern science diplomacy in all its taxonomical forms successful.

Specific areas of application for diplomacy (with)in science

The preceding sections have introduced our notion of diplomacy (with)in science and related it to the normative framework of the right to science under international human rights law. In what follows, we develop and motivate the concept of diplomacy (with)in science further by illustrating two potential areas for its application. The first of these concerns blockchain and roughly illustrates diplomacy *within* science; the other examines the general common good as an example of diplomacy *in* science.

Blockchain and decentralised science: diplomacy within science

> I am the nothing that makes everything happen. You don't know me, you don't understand me; and yet still, if you want justice, I will help you to find it. I am blockchain. I am encryption. I am code. Now put me to use.[52]

What pumping seawater out from under glaciers does for the tangible environment in *The Ministry for the Future*, blockchain does for the digital environment. In Robinson's hands, blockchain provides the technical substrate for several important innovations: a carbon coin, originally introduced to provide economic incentives for carbon sequestration, but which ends up becoming the de facto world currency; financial transparency through the immutability of the blockchain data structure tracking the movements of this currency, bringing with it the end of tax avoidance; a micropayments system, through which individuals are paid in carbon coin for the use of their financial, health, and other data on a pay-per-use basis; and the ability to leverage digital assets in the form of this personal data for micro-loans and other banking and financial services, a 'direct democracy of money.'[53]

One way of ensuring that rights- and stakeholders are heard in practice is through the use of technology that facilitates participation in scientific processes. Powering these innovations – imagined, in Robinson's case, but all of them based on real-world analogs – is blockchain technology. The term 'blockchain' is usually associated with cryptocurrencies such as Bitcoin and Ethereum, but actually it refers to a set of advances in cryptography, game theory, and computer science – a set of conceptual and technological innovations which, when added together, allow for secure and transparent transactions directly between individuals. Blockchain data structures were first described in 1991[54] by academics Haber and Stornetta, but were not implemented in practice until early 2009, based on a famous whitepaper by Satoshi Nakomoto (a pseudonym).[55]

Blockchains consist of 'blocks' of data which are 'chained' together sequentially in time. One block contains all the information about transactions that have occurred in a certain timeframe. Cryptographic hashing functions and time stamps are used to order ('chain') blocks together sequentially in time and to guarantee that the information contained in the previous block has not been tampered with (or, if it has, that this change will be immediately obvious). There are various mechanisms, known as *consensus mechanisms*, which operate to designate a particular version of the blockchain as the canonical, that is, accurate, one. Various consensus mechanisms leverage economic incentives in the form of compute costs,[56] stake,[57] or authority[58] to establish agreement on the canonical version of a blockchain.

Some blockchains allow for programmes to be included in, and executed on, the data contained in these blockchains. Such programmes are known as 'smart contracts.' The combination of mathematically guaranteed data integrity and the ability to operate smart contracts can combine in ways that permit the functions normally carried out by intermediaries instead to be carried out automatically by pieces of code.

In *The Ministry for the Future,* this functionality is used to issue and keep track of carbon coins, and to enable access to automated micro-level financial services. The application of blockchain-enabled financial services, such as loans and brokerage, is known as decentralised finance (DeFi) – decentralised because the financial services offered are

enabled by the collective sharing of resources according to programmed rules, rather than by a (centralised) financial institution such as a bank.

Crucially, however, blockchain data structures are agnostic to the information contained in them; they work the same whether the data tracked concerns financial transactions or the exchange of any other information. For the same reason that decentralised finance has seen rapid adoption – reduction in fees and latencies through automation and disintermediation leading to financial services becoming available to people without much capital – efforts have begun to apply blockchain technologies to science. Known as decentralised science (DeSci), these efforts are based on the observation that science, like finance, requires trust in the integrity of information shared between peers: 'Scientific information in its essence is a large, dynamic body of information and data that is collaboratively created, altered, used and shared, which lends itself perfectly to the blockchain technology.'[59]

To progress, science requires the exchange of data and hypotheses in ways unbiased by non-scientific considerations; and the more individuals participate in this process, the faster science can progress.[60] The combination of data integrity and smart contracts have several useful applications in scientific ecosystems including, but not limited to, means of increasing participation in the conduct of science;[61] reducing costs, delays, and other inefficiencies in accessing and publishing scientific outputs, as well as in administering scientific projects;[62] providing alternative incentive structures and sources of funding;[63] removing sources of bias in research conduct and reporting;[64] and enabling novel organisational structures for scientific cooperation, decision-making, reputation management, and priority-setting.[65]

DeSci exemplifies a technical implementation of diplomacy within science. It creates mechanisms for the transfer of data, hypothesis, and funding between actors that do not know or trust one another and who might not otherwise have access to these resources, thus opening up scientific processes to greater input from scholars working in under-funded areas, to citizen scientists, and to interdisciplinary projects which might have difficulty getting started or publishing their results under current funding and publication arrangements. These aspects of DeSci make it a practical means of increasing the freedom to participate in scientific processes.

This freedom, and other rights and freedoms subsumed under the right to science, cannot, however, always be guaranteed. In certain cases, it will be necessary to place limits on scientific freedom and conduct to prevent developments which produce more harm than good. One way of doing so is to leverage the general common good element of the general limitations criterion in Article 4 ICESCR.

General common good: diplomacy in science

As mentioned above, Article 4 ICESCR requires that any limitations on the right to science be 'determined by law and only in so far as this may be compatible with the nature of these rights and solely for the purpose of promoting the general welfare in a democratic society.' The latter part of this formulation requires that the general interests of society be considered when evaluating limitations on the enjoyment of the right to science. As we will see, this requirement was introduced in order to ensure that the general limitation criterion is interpreted restrictively, i.e. to ensure that rights, including

the right to science, can only be limited where this is truly necessary for the general well-being as opposed to factional interests. As such, the general wellbeing element of the general limitations criterion can serve as a normative and political standard to which science diplomats can hold states accountable to ensure that no barriers to scientific progress are introduced that are not strictly necessary.

Limitations on the enjoyment of human rights are not necessarily problematic. Rather, they reflect the need to balance the interests of the individual against those of the wider community, as well as to weigh competing rights claims.[66] Article 4 ICESCR was based on Article 29(2) UDHR, which provides that: 'In the exercise of his rights and freedoms, everyone shall be subject only to such limitations as are determined by law solely for the purpose of securing due recognition and respect for the rights and freedoms of others and of meeting the just requirements of morality, public order and the general welfare in a democratic society.' The *travaux préparatoires* show that reference to 'the just requirements of morality' and 'public order' were added to 'the general welfare' since the latter term had a narrower meaning in French than it did in English, referring essentially to social and economic wellbeing.[67] These additional purposes legitimising limitations would eventually make it into the ICCPR, though not the ICESCR.

During the drafting of the ICESCR, a US proposal based on Article 29(2) and likewise referring to morality, public order, and the rights and freedoms of others was rejected on the grounds, firstly, that these terms were too vague and, secondly, that 'while considerations of public order and morality might justify limitations on civil and political rights they do not seem to be relevant in the same sense with respect to limitations on economic, social, and cultural rights.'[68]

As it appears from the *travaux,* a primary reason for failing to include additional grounds of limitation was to ensure that limitations could not be easily justified by vague references to 'national security' or 'economic development.' One way to reconcile these competing views might be to require States to demonstrate that any invocation of national security, economic developments, public order, and the like is legitimate 'only in so far as they are genuinely synonymous with 'the general welfare'.'[69] Thus, if a State party seeks to limit the right to science for reasons, say, of economic development, the State party must further demonstrate that the economic considerations at issue reflect the general wellbeing of the entire society as opposed, say, to only that of publishers or pharmaceutical companies.

The general wellbeing element of the general limitation criterion can thus be viewed as a powerful diplomatic tool which can be wielded from within science against unjustified State interference in scientific processes. This versatile tool can also be used from outside science, for example by State parties, to introduce those limitations which truly are necessary. In either case, the tool reinforces the importance of the general common good over individual interests. As such, it serves as an important counterweight to the traditional focus of human rights instruments on the interests of the individual.[70]

Concluding remarks

Kim Stanley Robinson's *The Ministry for the Future* was published a couple of years before the UN General Assembly adopted a historic resolution declaring access to a clean and healthy environment a universal human right.[71] Originally presented by

Costa Rica, the Maldives, Slovenia, and Switzerland, this resolution notes that the right to a healthy environment is related to existing international law and calls upon States, international organisations, and business enterprises to fight for a more healthy environment for all. As a rare innovation in the field of human rights and the environment, it joins a resolution declaring the 'right to water' a human right – with large-scale implications for water conservation, management, and access to this most basic and important of resources.[72] We can only hope that these resolutions will have the same impact in reality as the Paris Agreement has in Robinson's novel – that they will become a turning point in human history and the birth of a good Anthropocene.

We have argued in this article that activating the human right to science as a science diplomacy tool may help make modern science diplomacy for the Anthropocene successful. This diplomatic tool has the potential to complement anticipatory approaches to science and technology by furthering the same goals. It does so by providing technical and normative means to help address and ameliorate factors that inhibit, distort, or bias scientific processes, such as the influence of sectarian interests on scientific funding and development. It also provides technical and normative means of increasing participation, diversity, and inclusion, which, in addition to being valuable in and of themselves, also facilitates scientific progress by increasing the scientific workforce and the breadth of its combined experience. By removing distorting forces, furthering political and financial support for science, introducing well-thought-out normative standards for scientific integrity, responsibility, and freedom, and increasing the diversity and depth of the wisdom of the scientific crowd, right to science-based diplomacy (with)in science can be a significant meta-level factor for the facilitation of beneficial science and for the inhibition of harmful science.

Along with the other rights outlined in Article 15 ICESCR, the right to science embodies principles that are intended to inform the conduct of science.[73] As a *cultural* human right, it paves the way for ethical and human-centered deliberations becoming a more integral part of the scientific endeavour, links scientific freedom to scientific responsibility, and 'adds a legal and moral dimension to a range of fundamental issues, including scientific freedom, funding, and policy, as well as access to data, materials, and knowledge.'[74]

Some scholars have argued that the drafters of the UDHR and the ICESCR made a mistake when they categorised this right as a cultural human right.[75] We beg to differ. As one of those economic, social and cultural rights that the drafters of the UDHR considered to be 'indispensable for [a person's] dignity and the free development of [their] personality,'[76] the right to science, along with the other rights listed in Articles 23 through 27 UDHR, is groundbreaking because it aims at the realisation of the development of one's self.[77] The very fact that it was originally categorised as a cultural right enables us to see science, 'done' by both professional and citizen scientists, as a part of culture and to apply ethical, social, and cultural concerns to scientific scholarship just as we do to any other kind of scholarship. It allows us to take into account human rights and social values when we approach the issue of authors' rights (Article 15 (1)(c)) and intellectual property (IP).[78] It also makes it possible 'to capture the full spectrum of ethical, legal, social and political concerns that arise and to mediate the inherent tensions and trade-offs associated with emerging science and innovation and their regulation,' for example with regard to international environmental law.[79]

Thus, science as part of culture broadly understood reminds us of one of the noble ideals underlying both: the furthering of human creativity and learning for the benefit of the individual and society.[80]

Notes

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2. This is the opening line of the novel. Ibid, 1.
3. Ibid, 16.
4. Ibid, 91.
5. Ibid, 251.
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15. See e.g. James Poskett, *Horizons: The Global Origins of Modern Science* (Mariner Books, 2022).
16. See e.g. Ruffini, 'Conceptualizing Science Diplomacy'
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30. https://opensource.com/resources/open-science
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34. See *Critical Voices – UNESCO's Instruments in Defence of Freedom of Expression of Artists, Journalists and Scientific Researchers*, produced by the Permanent Delegation of Denmark to UNESCO – available at https://unesco.um.dk/.
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41. UN CESCR, General Comment No. 25, para 41.
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76. Article 22 UDHR reads: 'Everyone, as a member of society, has the right to social security and is entitled to realization, through national effort and international co-operation and in accordance with the organization and resources of each State, of the economic, social and cultural rights indispensable for his dignity and the free development of his personality.'
77. Johannes Morsink, *The Universal Declaration of Human Rights: Origins, Drafting and Intent* (Philadelphia, PA: University of Pennsylvania Press, 1999), 212.
78. See Laurence R. Helfer and Graeme W. Austin, *Human Rights and Intellectual Property: Mapping the Global Interface* (Cambridge, UK: Cambridge University Press, 2011), 144. – We flesh out this line of thinking in more detail in Porsdam, *Science as a Cultural Human Right*.
79. Anna-Maria Hubert, 'The Human Right to Science and Its Relationship to International Environmental Law', *The European Journal of International Law* 31, no. 2 (2020): 626–7.
80. Cf. the reports by UN Special Rapporteur in the field of cultural rights, Farida Shaheed.

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