I am proud to announce a special issue of *Global Environmental Politics* on new technologies, edited by Simon Nicholson of American University and me, is now available. We write in the introductory essay:

Human beings are at once makers of and made by technology. The ability to wield tools was an essential ingredient in propelling an otherwise unremarkable ape to a position of dominance over ecological and even planetary affairs. This dominance has been attained through a remaking of the physical world and has produced a planet fundamentally altered. Technology, this is to say, has been central to history and human-induced environmental change. Our earliest significant environmental impacts appear to have been mass extinctions of megafauna, especially in North and South America, Australia, and the Pacific Islands, enabled by hunting and trapping tools and techniques. These were followed by large-scale land use changes from the rise of agriculture, another early set of technologies that were key to Homo sapiens' success.

Technology presents a paradox. Existing, emerging, and anticipated technologies offer remarkable possibilities for human well-being and the environmental condition. Since 1900, global average life expectancy has more than doubled and continues to rise. Most people can access information and educational opportunities that in the not-too-distant past were restricted to a tiny elite. The growth of farmland – which may be the leading direct driver of change in nature – has recently been reversed through agricultural intensification. Ozone-depleting substances have been largely replaced by synthetic substitutes. Preventing further anthropogenic climate change rides on lower-cost renewable energy, electricity storage, and carbon dioxide removal. Evidence shows that technology-enabled economic security allows societies to invest in protecting natural areas, ecosystems, and species for their own sakes. And writing in the era of COVID-19, quarantines, and sheltering-in-place, one realizes that the only route to quickly returning to normalcy is through the development of a vaccine. Ultimately, political scientist Jonathan Symons asserts that "democratizing and accelerating the pace of technological change is an essential element of any effective *response to Anthropocene challenges.”*

At the same time, though, technologies are often implicated in the most pressing environmental problems of our age. The patterns of industry facilitated by modern technologies are responsible for massive environmental change, from localized pollution to ecological distress on a global scale. Irrigation salinizes soils, while online black markets enable continued illegal trade in endangered species and their products. The requisite energy to power the contemporary world still derives mostly from fossil fuels, whose greenhouse gases are causing global climate change. And at the extreme, one of the markers of the post-World War II era is our technological capacity to destroy the bulk of life on earth, whether by choice or error.

In the issue:

- Leslie Paul Thiele examines what he calls “ecological restoration technologies.” Thiele focuses on the use of the emerging tools and techniques of synthetic biology and their potential application for assisted evolution and the “de-extinction” of species. The article assesses the enormous potential of synthetic biology to mitigate biodiversity loss. Importantly, it also poses a range of ethical and governance questions that should be addressed if synthetic biology, or other ecological restoration technologies, are deployed to alter the biosphere. Thiele makes the case that human beings are on the cusp of creating a new, managed nature – Nature 4.0 – characterized by the use of sophisticated technologies to “rescue and resuscitate the natural world.” We are racing headlong, he suggests, into the transformation of a planet that we are just beginning to understand.
- I focus on an emerging technology within Thiele’s discussed domain of synthetic biology. “Gene drives” are genetic modifications that can rapidly propagate through a population via mechanisms of biased inheritance. Scientists are developing them for purposes that include both the conservation of biodiversity – by eliminating invasive alien species, protecting endangered species, and fostering adaptation to threats such as climate change – as well as human well-being via, for instance, eradicating disease vectors. Gene drives’ potential outdoor testing and use are highly contentious due to environmental risks and social challenges. Given the importance of these activities’ governance, I describe and analyze the applicable international law and decisions of intergovernmental institutions, given in more detail in a recent post. A pre-print of my article is available here [PDF].
- Jennifer Clapp and Sarah-Louise Ruder take us into the world of precision agriculture (open access). Precision agriculture combines new digital technologies with new forms of genome editing. The vision is of autonomous farm equipment operating

independently on farmland that is mapped and monitored by sophisticated surveillance equipment, overseeing the growth of seeds modified using cutting-edge tools for biotechnological manipulation. Clapp and Ruder outline all that is new with precision agriculture. They also show us all that is old, by placing these technological developments in the context of prior technology-driven changes to agriculture. The article maps a vigorous debate. On one side are those focused on the potential sustainability benefits of precision agriculture. On the other are those who see precision agriculture as undermining sustainability by concentrating corporate power and entrenching destructive agricultural practices.

- My Emmett Institute colleagues Edward Parson and Holly Buck consider the long-term use of carbon dioxide removal (CDR). If CDR is indeed utilized at the scale implied by current scenarios that would likely keep global warming within 2°C, then an enormous multi-billion or -trillion dollar industry would arise. Accompanying this will be institutions, policies, industries, workforces, and political constituencies that establish, maintain, and benefit from these large financial flows. The CDR endeavor would need to end once atmospheric greenhouse gases are stabilized and perhaps lowered. However, akin to the contemporary challenge of ending fossil fuels, the associated interests are unlikely to go gently into the night but instead mount political resistance. Parson and Buck note that early decisions regarding which CDR methods and policies are to be dominant will make this phasing out more or less difficult. Their specific suggestion is to incentivize large-scale CDR via public procurement instead of a price on removed carbon or encouraging removed carbon's utilization.
- Finally, Joshua Horton and Barbara Koremenos start not with technology but instead with theory. Transnational climate governance, they note, is a popular and influential framework for studying nonstate and substate actors in global environmental governance. However, Horton and Koremenos argue that the transnational climate governance framework too strongly emphasizes steering (that is, direct governance) at the expense of influencing (or indirect governance) via informing, lobbying, and enabling. This lacuna is evident when considering the governance of researching solar geoengineering. There, the active transnational nonstate actors are disseminating knowledge, building scientific capacity, and pressuring and persuading governments and intergovernmental institutions to adopt their favored policies. From this, the authors conclude that scholars' analyses of global environmental governance should incorporate emerging work synthesizing research on interest groups and nongovernmental advocacy organizations as well as existing research on epistemic communities and capacity development.

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