

Beyond climate

A group of psychologists, biologists and economists recently argued (Lee Ross *et al.*, *BioScience* **66**, 363–370; 2016) that one reason our efforts to address climate change have amounted to so little is the nature of the human brain. The brains of our ancestors — and our brains by inheritance — were shaped by evolution for the problems our ancestors encountered. We can instantaneously recognize facial expressions and the emotions they reflect; we're instinctively skilled at navigating complex social interactions. Our more abstract thought allows us to plan to meet threats to ourselves or communities. But climate change is a problem of another category.

Climate change doesn't engage our instincts in the same way a snake does, or a charging bear. For all but the youngest of us (and maybe even for them), the threats posed by climate change lie too far in the future to matter in a personal accounting. We'll never see the consequences of our actions today, because of inertia in the climate system. Evolution hasn't trained us for future threats affecting only our distant descendants. Hence, for humankind, climate change is a problem that resides in a mental, social and institutional blind spot.

I think this argument makes considerable sense. Our instincts may not be the main problem, but they contribute. Yet there may be another, even bigger problem with our thinking too. Many of us approach climate change as a problem to be solved by humanity and put behind us. Certainly, the global corporate and political community thinks that way, as do most environmental activists as well as those working for the Intergovernmental Panel on Climate Change. But what if climate change is only the first manifestation of a much more profound problem — the passing of a threshold at which our technology and activity so change the planet that it becomes a different place?

To take one example, I've written before (*Nature Phys.* **8**, 775; 2012) about how soon the waste heat from human energy use of all kinds will lead to significant climate warming, even if we do manage to reign in CO₂ emissions. Estimates put that moment at only 100 years or so in the future, if energy use keeps growing in line with historical trends. In this sense, CO₂ is only the first stage of human-induced climate change, with others to follow. Along with these may



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come further non-climate-related problems also linked to our enormous impact on the planet.

A book from a couple of years ago — *Climate Conundrums* by William Gail — examined this idea in great detail. In planning for the future, he suggests, we're not yet even having the right discussions.

Gail argues that climate change is actually a harbinger of difficult issues that are emerging now but that society may only recognize a century from now. These might include things like new kinds of financial instabilities and cyber wars, global outbreaks of infectious agents, internet-mediated breakdowns of critical infrastructure such as the energy grid and resource conflicts, perhaps increasingly over resources such as water. We might see associated human migrations on an unprecedented scale. These problems will be linked to the rapid advance of our technology and the ever-growing scale of human activities. Climate change is only the first example of what is to come as our human presence begins to dominate nature, and we scramble to understand what's happening.

Quite possibly, he suggests, we might even see an actual reversal of our historical progress, and an ongoing decline in our capabilities. The idea isn't that our store of knowledge will actually decline, but that lots of it may increasingly become irrelevant to the problems we face, which in turn could be far more complex than anything we've faced before. There are many historical examples of advanced civilizations collapsing due to their inability to adapt to new problems; old skills remained, but were worth much less.

In our case, Gail suggests, it could happen as our impact on nature so changes its character that our old knowledge of its workings becomes inapplicable. Imagine, for example, that climate change seriously disrupts ocean currents. Then today's knowledge of those currents, based on long history and familiarity with the planet, will become of historical interest only. We'll be affected by new currents, and new patterns

of rainfall and weather, with little practical knowledge of what to expect. Similarly, we understand a lot about agriculture in the relatively stable climate of the past 10,000 years, but that knowledge may not apply in a world with global temperatures on average some 4 °C higher.

Gail is a former president of the American Meteorological Society. Yet *Climate Conundrums* isn't a study on climate change. It contains little data on rising temperatures or the various failed and ongoing efforts to reign in CO₂ emissions. Rather, this is a book about how climate change makes us think and react as humans, and how we should expect our thinking to change as we enter an era in which humans are no longer a small part of nature, but the largest force within it. It's an alarming work, and one of speculation, of course, as are all efforts to outline the future, especially centuries in advance.

Maybe none of the bleak problems he foresees will come to pass. But Gail offers a considered argument for why we're likely to be routinely shocked and surprised by a coming string of global challenges that will test our ability to adapt. One reason: we may find that well-intentioned attempts to understand our world more clearly may paradoxically make our problems worse. Suppose, for example, that we learned that global warming, by melting polar ice, would make accessible vast new reservoirs of fossil fuels. Such a discovery might well make climate change much worse by touching off a geopolitical scramble for that energy. A second difficulty: the new problems that emerge, global in character and taking place in a new nature powerfully shaped by human activity, will tend to be unprecedented, and fall outside of our historical experience.

Climate Conundrums isn't the kind of book one would expect to be written by a president of the American Meteorological Society. It's more of a philosophical exploration of our thinking concerning nature, and where our ideas fall short in a world that is rapidly becoming something new — because of our own actions. Much in the human mind rebels even at the thought that nature is changing irreversibly, and that the nature our ancestors knew, and for which we're so well adapted, is vanishing before our eyes. The new, emerging nature may be an unpredictable place. □

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