

AGU BOOKSHELF

Future Earth: Advancing Civic Understanding of the Anthropocene

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The Anthropocene, a term first coined in the 1980s by biologist Eugene Stoermer, is a word that encapsulates a powerful idea—that the world is now in the throes of a novel geological epoch, a period of time in which human activity, not natural cycles, dominates many of Earth's chemical, geological, and biological systems. The growing realization of our importance has caused a reanalysis, both scientifically and ethically, of our relationship with the natural world.

Though not an officially recognized epoch, the concept of the Anthropocene embodies the dominant frame of mind guiding many practicing Earth system scientists. In the AGU Monograph Future Earth: Advancing Civic Understanding of the Anthropocene, editors Diana Dalbotten, Gillian Roehrig, and Patrick Hamilton explore how this shift in perspective can be passed on to the public at large. In this interview, Eos talks to Diana Dalbotten about closing the science-society gap, the importance of local knowledge, and the oft-underappreciated power of children.

Eos: *Climate change brought on by greenhouses gas emissions is only one example of how humans are affecting global processes. What else are we doing to warrant the idea that now is an entirely new geological epoch: the Anthropocene?*

Dalbotten: Patrick Hamilton, one of the coeditors on this book, does what I think is a really great job of recounting how on the land, in the oceans, and in the air, human beings have had significant impacts.

In his chapter, Patrick talks about farming and its impact on sedimentation and erosion. He wrote about how humankind has changed the courses of rivers and deltas and how we've reached the point where we're actually depleting the fish populations of the oceans. Then, when you look back 200 years ago at the forests that covered different continents and how few of them are left, that's really a huge and major impact. Urbanization is another huge factor, where we've been paving over much of the landscape and now have fewer and fewer wild areas left. Sprawl is coming to more and more remote regions, and it seems to be happening very quickly in all different cities and continents.

Eos: *Despite the overwhelming scientific consensus around global climate change, public acceptance remains low and prone to swings in the weather. The book outlines some ideas on how to narrow the science-society gap. What are some of these?*

Dalbotten: I think that the best scientific communication happens when research institutions or scientists partner with other communities, such as the K–12 school system, museums, informal science organizations, or citizens groups, so that they can get to be known by the public and get their message directly to the public.

Many scientists are professional college teachers. In my experience, I've found that

many scientists are used to delivering their message, but they're used to delivering it to people who have a pretty high-level motivation to learn—they have to get grades, for example. The public doesn't necessarily have those kinds of motivations. I think that a lot of good informal science or outreach involves finding out where the public is at, or where the K–12 students are at, both intellectually and physically, and trying to meet them halfway. In my work on diversity and science education with the National Center for Earth Surface Dynamics, I always try to find where there is an intersection between the interests of the scientists and the interests of the communities that we're working with.

I really think that an important part of making a science partnership is that the scientists themselves have to be helped along to learn to listen to the community to hear what their

concerns are, what their needs are, what their desires are, and what they're noticing out there in the world. Oftentimes, the best way to connect with a community is to help them understand what's going on in their local area, rather than trying to deliver a single message.

Eos: *How is teaching people about the Anthropocene different from teaching science more broadly?*

Dalbotten: I think that climate change particularly, but anthropogenic change in general, isn't easy to understand. It doesn't fall into the scientific categories that teachers are used to dealing with or that people are used to understanding. The issues are extremely complicated, and to understand them, you need to understand a lot of different types of science.

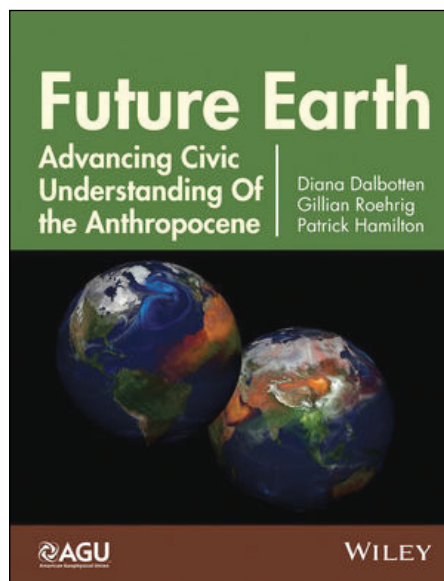
Even within scientific research, from what I have seen, the idea of the Anthropocene has forced scientists to take a different approach—they're being forced to work more interdisciplinarily. They have to take more of a systems perspective than maybe they did in the past. I think that's been reflected in the teaching. Education in the age of the Anthropocene has to be much more systems based and much more interdisciplinary than it had to be in the past in order to get the concepts across.

Adding to the complication is the fact that the idea of the Anthropocene is relatively new to the way we teach science. A hundred years ago, people didn't have to teach anthropogenic change. In comparison, the core way of teaching something like chemistry or physics has been in place for a very long time. So this is all rather new.

The new Next Generation Science Standards, I think, actually give teachers one of the broadest mandates to teach in a way that climate change is adaptable to. One of the things that Fred Finley wrote about in his chapter on reforming the K–12 educational system to include more focus on the Anthropocene is that it's not just an issue of stuffing more Earth system science into the curriculum. Instead, it's really a matter of partnering with other disciplines so you can get the message across without eating up giant parts of the school day. The time that we have to teach our children during the school day is short, and teachers are very pressed to cover the material that needs to be covered. By partnering with each other (for example, an art teacher might partner with a science teacher), the two different disciplines can support each other.

Eos: *What was your major motivation when putting together this book?*

Dalbotten: From my vantage working in education and outreach, it really feels like scientists are becoming more and more interested in finding ways to reach out to the public, to be in the classroom, or to help somehow with efforts to get science into the community. So we wanted to provide, first and foremost, a useful manual or handbook that could be picked up by a scientist who is interested in doing more science outreach. We wanted to



provide a place where they could come and find out about many examples of things that have been working.

We also wanted to provide a forum for the work of as many really excellent science communicators, informal educators, and education researchers as possible—people who have been forging new ground in these fields. We wanted to bring all of these advances together in a format that is useful to people outside of these specific areas.

The Anthropocene, I think, presents such a new challenge for science educators and communicators. We need to improve the way we teach and talk about the Anthropocene so that we can support dialogue that's open and not highly politicized. We need to find ways to talk about these issues, which are crucially important to society right now.

Eos: *One thing that stands out about the book is that it seems to strike a generally positive and hopeful tone. Was that a conscious decision?*

Dalbotten: In short, no, it really wasn't a conscious decision. But I do think that I and my coeditors are very hopeful, positive people. I think that's not unusual in the group that does informal science outreach and education research. The other editors and I didn't in any way dictate to the chapter authors how they should approach what they wrote. We just worked to invite the best people we could find. It was surprising to me, too, how much people gravitated away from saying, "This is a huge mess and we'll never get out of it." We're people who are looking to the future populations to help us find those answers. We're working a lot with young people. Maybe that makes us a more hopeful group.

Eos: *Traditionally, scientific and indigenous knowledges have been placed at odds: one is seen as a system of context and history, where humans are a component of the environment. The other has typically put human efforts outside of the environment, with science as a tool to look in. As discussed in the book, how can these two types of knowledge work together? What would be the benefits of doing so?*

Dalbotten: Many indigenous cultures have beliefs about the natural world that tie together spirituality and knowledge and observational

practice in a way that we, as westerners, may not immediately understand but that make a sensible, coherent, and understandable system.

In northern Minnesota, I work closely with the Fond du Lac Resource Management Division. In my understanding, how they manage their wild rice is through a blend of modern science techniques and traditional practices. They have scientists, of course, who work at the reservation. But these scientists work closely with local elders to understand, for example, what the rice lakes were like in the past, what the rice yields were on the various lakes, and which lakes used to have rice and don't anymore. It's not just a matter of understanding the past but of understanding the ways of doing things that may not immediately be apparent why they work. In many cases, there are real reasons why things are done a certain way.

In some ways this dichotomy you mentioned between traditional science and indigenous knowledge is changing a little bit, particularly when it's related to the Anthropocene or anthropogenic change. As I mentioned earlier, scientists are being forced to work in a way that's more interdisciplinary and more systems-oriented. That, I think, comes closer to the traditional indigenous way of seeing the universe. So in a way, the science community is actually moving closer to this way of understanding knowledge.

Eos: *Some of the approaches to expanding people's awareness of the Anthropocene discussed in the book, like educational reforms or creating learning opportunities at informal centers such as zoos and aquariums, seem like longer-term goals meant to bring about generational change. How does this mesh with the relatively short timelines required for action to mitigate global climate change?*

Dalbotten: That question, to me, requires more than one response.

First off, the science community doesn't really move a whole lot more quickly than the growth process of a child. Students who were in my program when I first started working for the National Center for Earth Surface Dynamics in 2003, students who were in kindergarten and first grade and second grade

at the time, are now going into college. Some of them are in graduate school. That process happens a lot more quickly than we really notice. Kids grow up. I think we have to recognize that science takes place at a pretty glacial pace, and I think a bigger question than whether these students are going to be able to keep up with the change that's coming is whether the science community is going to be able to keep up with it.

In many cases, we're being too conservative about our forecasts. Change is happening much, much faster than scientists were predicting even a decade ago. The amount of science work that needs to be done has not been keeping up. The amount of modeling and data gathering and analysis that still needs to take place is probably more of a problem than the pace at which children grow up. So that's one side of the coin.

The other side of it is that the work we're doing to work with children through education reforms and science learning centers is not just reaching the children. When you reach the children, you reach all of the people that come with them. So parents bring their children to the museum—parents are learning alongside their children. Grandparents, too. Children bring things home from school. In some ways, parents have access to the same materials that their children have access to. We can reach multiple generations through that child, through the things they bring home and through the things they say.

I think that we can have a rippling effect on public awareness at a broad scale by reaching out to children. We tend to pretend that we don't listen to our children, but young people can have a huge impact on public opinion because they're intelligent and passionate and activist. When you impact children, they get out there and they impact the world.

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—COLIN SCHULTZ, Writer