



## **An Archive for the Future: Paul N. Edwards on Technology, Historiography, Self, and World**

ALEXANDER MONEA  
North Carolina State University, USA

PAUL N. EDWARDS  
University of Michigan, USA

In this conversation between Paul N. Edwards, professor in the School of Information and the Department of History at the University of Michigan, and Alexander Monea, doctoral candidate in the Communication, Rhetoric, and Digital Media program at North Carolina State University, Edwards addresses several concerns related to the history and critical analysis of media and technology. In particular, Edwards discusses archival methodology and interdisciplinarity in media studies, theories of technological momentum and infrastructural innovation, the political stakes of historiographic inquiry in terms of media and technology, the importance of the work of Michel Foucault, and the production of the self or subjectivization. He also discusses the contemporary implications of his earlier work on the history of computation and more recent work on climate science.

*Keywords: media genealogy, philosophy of science, history of technology, climate science, computation*

### **Alexander Monea:**

The first question that I would like to ask you is a methodological one. For someone who writes so much about knowledge infrastructures, I think that it is interesting to note that in your work there are only short elaborations of a methodology. So much interesting and wonderful work is being done in fields like media archaeology and science, technology, and society that is largely historiographic in nature, but so often that work diverges from traditional notions of historiographic method in ways that are left implicit, or even opaque. As a reader, I often find that the ways in which these authors are leveraging historiography for their own critical analyses goes unremarked, which leaves those of us who might want to contribute to or help establish these new fields at a loss for how we might best do so. An example of this might be your recent work in *A Vast Machine* (2010), where you note that a lot of the archival materials and communications that you are examining come from “gray literature” like conference presentations, personal correspondences, and unpublished internal communications like memos, manuals, etc. What I am curious about here is whether there might be some methodology that perhaps spans across your work that might provide some clues as to how you go about discovering, investigating, and establishing which

documents are important to your archive. How do you produce your archive and navigate between canonical documents and those which we might describe, tongue in cheek, as having flown under the radar?

**Paul N. Edwards:**

That's a really good question. One method I used a lot, especially in my first book, was tracing citation trails. I'd start with some recent publication I thought was interesting, see what it cited, and then explore those citations and see what they cited, and try to trace crucial ideas back to their origins. In my first book, that led me to George Miller and the Psycho-Acoustic Laboratory at Harvard, which turned out to be a really important little place even though not very well known for what it did during the war. So many of the things that I looked at all led back to those people and their publications. That intuition was validated by the Science Citation Index, which is really a useful resource for history because it tells you what people thought was important at the time. So I used that some, but in the climate science work, a lot of it's more recent and there are few archives of the traditional sort, since climate scientists were early adopters of computer technology, including e-mail. There are some. There's a Jule Charney archive at MIT that's pretty extensive, and a few others. The National Center for Atmospheric Research hired an archivist. She spent five or six years trying to organize things there. Outside the library, there wasn't very much to begin with; there just was not that much there. So how do you find out what's important? In the climate case, a lot of it was just talking to scientists and hearing them repeat various themes and asking them what they thought was important. You know, for example, there was this thing called the Stanstead Seminar in Canada in the 1960s, where they talked about spectral modeling techniques. That's a really obscure topic but really important to climate science, and several people mentioned how important these conferences were, saying things like "As a graduate student I went to this conference, and I learned these things that became my whole career." So you know, a lot of it is just opportunistic. There is no easy way to tell whether you have totally mastered the whole thing, especially if you pick a really big topic, like I did. [Laughter]

**Paul N. Edwards:**

I think this is true of all historiography really. There are certainly some perfectionists, historians who are able to totally, comprehensively master the archives that they work with and have a complete grasp of it. But that's not most historians. I often criticize my colleagues in history, though, for writing sentences that begin with "Many 19th-century Victorians believed that . . ." or some such thing, and then you read to the end of that sentence and there's a citation to two or three newspaper articles.

**Alexander Monea:**

Right.

**Paul N. Edwards:**

How do we know that these articles really represent what most people thought at the time? It's a dodgy move people make, and I try not to do that. I try to be more specific about places and people to whom these things really happened, but there's just a certain point at which you can't know whether you've found all the important stuff or even the right stuff.

**Alexander Monea:**

That's really interesting. There may be no real answer to it in the end.

Well, one of the questions that I wanted to ask you today has to do with disciplinarity. Oftentimes, your work seems to be operating in interdisciplinary areas, and necessarily so because of the scope of the issues or problematic you are investigating. Take, for instance, your work on climate science that deals with a lot of technical specificities in the production of climate models, yet at the same time attempts to take the perspective of humanities-based critical theory in its analysis. How do you orient your own archival production and writing process to accommodate such an interdisciplinary project? How do you manage the need to appeal to audiences both inside and outside of a discourse?

**Paul N. Edwards:**

So one of the things I worry about is how not to be captured by the perspective of my scientific colleagues, because I like them. You know, I talk to them a lot, I go to some of their meetings, and I want to know what they think. But I also don't want to be a captive of their point of view. And I don't know that I'm completely successful with that. I'm not sure you can be when you get really close to a community. So I try to constantly remind myself that my job is to look at what they say and not to take it at face value, but to compare it with other perspectives and ideas. Can you repeat the second question, please?

**Alexander Monea:**

I am curious about how you position yourself archivally and in your writing style such that you are able to publish and able to stand among and work with people without necessarily being on one side or the other. In short, how do you negotiate the interdisciplinarity that seems unavoidable for any scholar hoping to perform a genealogy of a sociotechnical system or medium?

**Paul N. Edwards:**

Yeah. I mean, in the case of the climate book, I don't really understand why this is true, but there just are not that many people working on that particular thing.

**Alexander Monea:**

Right.

**Paul N. Edwards:**

It's a very technical area of science. It seems to require a lot of math and computer knowledge, and that scares off a lot of historians, because they don't have it. I have more of a background there than most historians, perhaps, but mainly I'm not scared of math or science or computers. When I went to college I wanted to be an astrophysicist but got diverted into the humanities. Still, I've always enjoyed reading technical literature. Most people just kind of freak out when they're faced with that. Very often when I'm reading scientific papers, I read the beginning and the end, and the math in the middle isn't something I can really process, but I have enough of a sense of it to understand intuitively what's going on, probably because I've been through so many iterations. I'm not competent to evaluate it as a scientist, but I can understand how it connects to the other pieces of the literature and understand, when they're having an argument, what the argument is about. So I think I was lucky in that case because I just—there just is not

a big constituency of people already working on it. If I were studying the French Revolution, it would be—you know, then I'd have to have some other way of distinguishing myself, but here, you know, there's Jim Fleming and Naomi Oreskes and me, and just a handful of others! Today there are a lot of graduate students, but until the last 10 years or so there just haven't been that many people working on the history of climate science.

**Alexander Monea:**

On a different note, I'd like to ask a few theoretical questions that are meant to engage your work as a whole, followed by some more specific questions about *The Closed World* (1996) and *A Vast Machine* individually. In both of those texts, I've seen you cite Thomas Hughes' work. In my own media genealogies, I've found Hughes' articulation of technological momentum to be quite useful, the basic outline of which is that socially produced problematics constitute the fields from which particular technologies arise and crystallize, after which point these technologies become increasingly stable, rigid, and difficult to alter. In short, technologies arise in a social context which they double back and inflect after crystallizing, the takeaway being that technological development is always sociotechnical in nature, but also that technologies are more easily amended in their earlier stages of research and development. In terms of this, I wonder how you might articulate your own understanding of sociotechnics and technological developments in relation to Hughes' idea of technological momentum. In terms of your own work, how would you articulate this process, and how is it different from Hughes?

**Paul N. Edwards:**

Well so, you know what Tom was trying to do, which has been the problem for historians of technology all along, is that they don't want to be technological determinists, and yet they want to acknowledge the fact that technology has shaping effects on people and societies. The momentum concept is a good one, because if you think of it in the classic billiard-ball way, momentum can be altered, but the larger it is, the harder that is to do. When a sociotechnical system runs into a problem, it can sometimes solve it and keep going, but the problem might also prevent it from moving forward, or it can get bounced off in some other direction by some new thing that comes in. Tom tended to talk about electric power systems, though later he did more stuff with other kinds of infrastructure. He was trying to express this snowball effect that happens when some new thing gets traction, and then lots of other things begin to connect to it and use it, to the point that it becomes hard to stop using it or stop it from growing. I think that happens a lot, but it's a bit different in the case of software-based systems, which are so much easier to transform than hardware and big, capital-intensive physical infrastructures. So you know Tom was really all about large technical systems, and that was the phrase he used. He didn't really talk about infrastructures, though maybe that is not a very different idea. He was often criticized for being elitist, because he focused mainly on movers and shakers—inventors, entrepreneurs, famous people—and not so much on the labor and maintenance that made those things keep going after they'd been invented. Labor history and maintenance just wasn't that important to him. To me, that's the heart of what makes infrastructures go: a lot of grunt work by people who mostly aren't acknowledged.

**Alexander Monea:**

I think that this is a good segue into the next part of my question. I think your answer is best reflected by the section of *A Vast Machine* where you describe the process by which an infrastructure is developed,

networked, and interconnected via gateways into a more heterogeneous internetwork or web. That process seems to be a bit more dynamic than what we see in Hughes' work, and it seems to have many more points of intervention than the process that Hughes outlines. Are these moments where gateways are being produced, infrastructures are being networked, and networks are being internetworked points of intervention? What sort of stakes can these points have for sociotechnical developments and for any agents that may want to intervene in them? If we understand Hughes to be speaking about the development of infrastructures or large technological systems, how does their susceptibility to networking and internetworking via gateways alter our ideas about their momentum? In short, can we look to gateway construction and networking for sites of agency?

**Paul N. Edwards:**

Well, my great colleague Michael Cohen, an organization theorist, when he heard me talk about this stuff he said, "What you're saying is that infrastructures are complex adaptive systems." They have a lot of moving parts, and when any one part changes, the others have to adapt to the change, and that's kind of how the infrastructure process goes. That's part of why it's so clunky. It moves along in sort of a chunky way instead of going smoothly. I think a lot these days about the idea of software ecology. I've been using computers since 1974, and I've seen a lot of change across that time. In the 1990s, when a major change happened in an operating system like Windows or Mac OS, all the software that you used on that operating system would have to update, and you would be responsible for knowing that and making it happen. You would have to get updates individually from every software producer, you know, for everything you used. Over time, that process has slowly been almost completely automated, so that now you can just click "update" and it all updates. What that represents is this vast, really complicated collection of actors, all these different enterprises that are producing stuff for a platform, a common operating system. They're all doing these updates at the same time, and they've now developed standards and techniques for making that happen in more of a seamless way. Those are phenomenal changes, and really different from the way most infrastructures have usually worked, where one was much more like, "Okay, we've got a new size of shipping container, and now everybody's going to have to figure out how they're going to get it on to the back of their truck because it's a little too wide to be legal in Europe, but it works in America," or something like that.

**Alexander Monea:**

Oh, that's okay. Let's move on to my next question. I think that in your work you seem to be indebted at times, and quite explicitly so in *The Closed World*, to a Foucauldian legacy. In light of that, I thought it appropriate to ask you some questions similar to those that I've seen Foucault asked over and over again in interviews about his historiographic work.

**Paul N. Edwards:**

[Laughing] Okay. Yeah.

**Alexander Monea:**

One of these questions would be: What, in your mind, is the political role or stake of historiography? In particular I mean to ask whether you find your own investigations to be wholly apolitical or if, instead, they are politicized in particular aspects. Your work is certainly metapolitical in the sense that it articulates

the stakes of particular discourses, technologies, and things like that, but I guess my question would be, should historiography have a political valence that's openly acknowledged and engaged with, and how do you see your work in terms of this? In short, which Foucault are you most indebted to: the archaeologist or the genealogist? And what are the stakes of that distinction for historiography?

**Paul N. Edwards:**

Well, when you're writing about climate change, you can't avoid political stakes. So that's part of the answer. It depends on what the topic is, but there's certainly historiography that doesn't have any particular importance to today, especially the further back you go. It might be really interesting, but essentially irrelevant, to current political events. In the early 1990s, some people in STS began to say things that I thought were politically irresponsible because there was a sort of triumphalist attitude about the notion of social construction. So that once you had shown that something was socially constructed, somehow you had debunked it or taken the air out of it, and it was then understood by some people to be a thing that we just made up. The historian's question is always: What might have happened if things didn't go the way they actually did? So an important event is one where, if the outcome had been different, the world would have been utterly changed. So if the Nazis had won the Second World War, or something like that. There was a sense about social constructivism that we were making a kind of revolutionary move by saying that a scientific idea or a technology is socially constructed. Some people thought we were saying that the world could be completely different; science could have just gone off in another direction altogether, with totally different concepts and conclusions, and I just don't think that's true. Sometimes it's true, but much more often it's not. [Laughter]

**Paul N. Edwards:**

So coming out of graduate school in an interdisciplinary program, I had a problem with packaging: What was I? And that got me caught up with thinking about this question: What are the political stakes of this position? And for me, I was interested in climate change, I was interested in the military and computers, and these are things that you can't talk about without taking a position. So what's your position based on? And that drove me out of pure theory into finding an empirical basis for any claim I was going to make, and I always wanted to know where it came from. So I think Foucault operated a little bit like that. You look at a problem like sexuality, or punishment, and say how was the past different, and what were the things that changed. What needed to shift to get from there to here? He always tried to ground his narrative in evidence. That gave it a concreteness, so he was never just making the claim.

**Alexander Monea:**

Yes, I think that in a lot of Foucault's work, but especially in his interviews, he notes that he can only rigorously articulate how a thing came to be at a particular place and time in retrospect. He's much more able to look at epistemes or apparatuses of the past than at those operating in the present. So one other theoretical question I might ask you is whether or not the historiographic mode of inquiry is only capable of coming to know a discourse retrospectively. I find this question to be particularly relevant to your own work on both the emergence of computation and climate science, because both are histories that run right up to the present moment and obviously still have very large stakes in the present. How do you think about things like discourse analysis, archaeology, and genealogy in relation to temporality? Can they only

function retrospectively? How might they be leveraged, if it is at all possible, for a critical analysis of the present or recent past and for active decision making and intervention?

**Paul N. Edwards:**

Yeah. Well I mean I'll just tell you what I tell my students, which is that I don't think you could do very good history of anything that's less than 20 years old. For things that happened more recently, you just don't know what's important. What turns out to be important might not be what you think is important at the moment. I'm based in a school of information. My colleagues and my students are obsessed with social media. Partly they're obsessed with what we could learn from them and the data streams that they've generated. That's one thing, but there's a tendency to think of these things as fixed and permanent, even though they're really very young. Facebook as we know it today is less than 10 years old. It's a major thing, and it has become a kind of benchmark as the way the world is always going to be. I don't think we know that. I think it could easily fade away and die in another 5 or 10 years, and only time will tell. Some other thing will come along and displace it. So it's very hard to tell the difference between things that are fads/obsessions of the moment and things that are truly really important in the long run. For me, that's 20 years or more.

**Alexander Monea:**

Okay, but do these examinations that can be done rigorously in that 20-year window maintain contemporary stakes? Take, for instance, your work on closed world discourse in terms of war, nuclear proliferation, and computerization. There are obviously still very present and imperative contemporary stakes of that sociotechnical development. Are these stakes similar enough that we can leverage work such as yours in the contemporary moment? Or is it the case that by the time you can articulate those stakes, they have already changed and no longer constitute a point of intervention? In short, is historiography, and genealogy in particular, always already too late?

**Paul N. Edwards:**

Well that's a good question too. So that particular example, I would say yes. The Obama drone warfare campaign is just the latest manifestation of that same worldview and those same techniques that I discussed in *The Closed World*. I don't have to say much about that; it's quite obvious. It's really a global surveillance system with satellites, computerized control of remotely operated weapons. It was all there in SAGE in the 1950s, and it's been elaborated and technically improved, but the system concept is not really different.

**Alexander Monea:**

That actually leads me to one of my more specific questions. In your work in *The Closed World*, I see a lot of parallels to the contemporary moment in terms of discourse. In that book you wrote about the ways in which closed world discourse led to a triple articulation of closure. The first closure was that of the capitalist world and domestic nationality, which envisioned communist spies and sympathizers as internal threats that might be anyone and anywhere. The second closure was that of the communist world and foreign exteriority, which envisioned the expansion of the "Iron Curtain" to encompass new countries as external threats to be met by proxy wars. And finally, the third closure was that of the entire globe as a nuclear stage, where the threat became a nuclear Armageddon. I would be interested to hear if and how you might understand the present moment in light of this. It would appear that in the case of "The War on

Terror” there is an even less identifiable and locatable enemy that has a peculiar capacity to lurk in the domestic realm and to evade our traditional strategies of containment by refusing to operate in terms of traditional borders. Yet the discourse remains remarkably similar, and we see a lot of the same sorts of McNamara style responses. You actually published *The Closed World* before any of this unfolded, right?

**Paul N. Edwards:**

Mmm hmm.

**Alexander Monea:**

So, as you watched this discourse on terror evolve, did you mark any particular parallels or divergences that you think might be interesting or useful?

**Paul N. Edwards:**

I gave a couple of talks on this in about 2002, 2003, after September 11. There are so many ways in which they just kind of turned the whole system on a new set of enemies. They’re much harder to track and much harder to localize. The closest parallel to what was going on during the Cold War now is China, and it’s cyberwarfare, corporate spying, and espionage. That situation really does resemble pretty much everything that was going on in the Cold War. Terrorism, a piece of it, is kind of another thing. It’s so local and so individualized, not so much about massive armies and global holocaust, but we see the echoes of the Cold War discourse when certain members of Congress respond to things like ISIS and Iran. You know, we should bomb them; we should go to war with this enemy because we have the eyes in the sky and we can track them and kill them. There’s that same Cold War–era belief that we can engineer political situations by force, in ways that are really probably lost to us at this point, certainly by those means, but the belief in the idea is very strong.

**Alexander Monea:**

Do you think that there are particular lessons from your investigations of this earlier period—which, of course, have some parallels as well as divergences—that might be applicable or that might be used as a line of inquiry into this current juncture for someone who might want to extend that work?

**Paul N. Edwards:**

The thing I did not know much about or really go into at the time was the NSA [National Security Agency]. Especially after Snowden, that’s something someone could really investigate along those same lines: the fantasy of global control and surveillance. We’ll listen to everyone’s conversation and track the bad guys that way. One big difference is that at least in the early part of the Cold War—and it probably went on until the 1970s, even into the 1980s—the military role in the industries that produced NSA-level equipment was still pretty large. That’s not true anymore. The military relies much more on private-sector development for almost everything it uses. It isn’t the innovator or the leader anymore.

**Alexander Monea:**

So in your talk today you mentioned the gap between perfect and usable knowledge, and it seemed as if the utility would obviously be defined by the truth criteria of a particular knowledge infrastructure or regime. You noted that with weather data, it’s very easy to establish its utility. You go outside and see if



the weather is the same as the forecast, right? One of my questions there would be how have scientists worked to establish truth criteria or usability criteria for determining how valuable a particular climate model or set of climate data is. What types of utility are they looking for or evaluating based on? Are there any set standards for evaluating the utility of a climate model?

**Paul N. Edwards:**

Yeah, so there are some, and they're interesting. So for the last three IPCC [Intergovernmental Panel on Climate Change] reports, there's been this thing called the Coupled Model Intercomparison Project (CMIP). It defines a set of standard runs that all the climate models that are going to be in the IPCC reports have to do. One of the most important ones is to reproduce the climate of the 20th century. You start with the climate of around 1900, and then you begin adding greenhouse gases in the amounts that they were historically added to the atmosphere, and see how the model performs. Does it reproduce what actually happened, or not? Do the effects of major volcanic eruptions show up on the model results? And then there are other things that become more technical, such as getting the right balance between warming at the poles and at lower latitudes, or reproducing the monsoons. So there are many tests like that, hundreds of possible runs that modelers can do to compare their performance with other models. So CMIP has created an important set of standards. Before that, the only standard was always just carbon dioxide doubling. What happens when carbon dioxide doubles over the preindustrial era? That became the benchmark early on. I view the CMIP exercises as a really important part of turning climate models from research science into reliable knowledge. The climate deniers tend to say that the modelers' all have a huge incentive to do well at reproducing the 20th-century climate, so you tweak all the knobs in your model to make it do that, even if that produces a scientifically incoherent result. I don't think that really holds up. The models are too complicated for undisciplined tweaking to work that way.

**Alexander Monea:**

In the introduction to *A Vast Machine*, you very candidly confess that you believe climate change is real, that it is the biggest threat to humankind now and potentially for generations to come. The structure of that text for me initially bore a resemblance to *The Closed World* in the style and depth of analysis. But what was interesting to me as I moved further into the book was the realization that it didn't seem to have the same turn as *The Closed World*, where you moved from looking at the development of technologies to the social construction of subjectivity. In terms of Foucault, we might understand the first section of the book to deal with power/knowledge, and the second section with the self and subjectivation. In particular here I am talking about the trio of chapters on cyborg discourse and how one might articulate a self in relation to closed world discourse. It is this turn that seems to be lacking in *A Vast Machine*, despite your belief that climate change is such an important issue for us to address. What I am curious about here is whether you have any thoughts on what the corresponding discourse of the self or schema of subjectivation might be to climate science as a power/knowledge structure. Where is the subject at in all this? How might it be articulated? Or is that a question for another book?

**Paul N. Edwards:**

That's an interesting question. A couple of years ago, Bruno Latour gave these Gifford Lectures on Natural Religion. He likes the Gaia idea, and the question he asked in those lectures was essentially: Who speaks for the Earth? And his answer was that scientists could be doing that, but instead they are taking the view

from nowhere. And the view from nowhere is a view with no stakes. It's not a commitment. So his answer was that scientists need to take on this role as the people who can speak for the planet, since it can't speak for itself, and I think I buy that. It's not necessarily calling for a particular political position, but that you have an investment of care in this vast entity of which you are a part; and it's—you know, everyone I know who has seriously engaged the climate change issue is depressed, and for good reasons, because we're not going to solve this problem in some straightforward way. Things are going to get much worse before they get better, if they ever get better. That's a very uncomfortable position, and it's one that does not encourage action, which leads to depressed people just sitting around and making themselves more depressed and drinking a lot. [Laughter] And for me, as well, that's been a difficult place to inhabit.

Part of why I like to think more about scientists and science than about the policy side of climate change is that I find the policy side so depressing and terrifying. So in this arena, I don't think I can do the same kind of number on the construction of the self that I did in *The Closed World*. If anything, human selfhood seems sort of irrelevant. When you confront climate change, or the even larger issue of the Anthropocene era, you start to see individuals as just tiny cogs in a colossal production and consumption system—what Peter Haff calls the “technosphere,” which has almost taken on a life of its own. That might sound like technological determinism, but it's hard to deny. The technosphere has a metabolism; it needs to ingest energy and materials to stay alive, and wherever that process is blocked, it finds other sources of energy and materials, most of which end up being destructive for the planet. The glorification of individuals and their choices is part of the mythology that keeps the technosphere alive; it's part of the engineering of desire that drives ever-increasing demand. The economic pie has to keep growing, you know. The age in which people and governments talked seriously about sharing the pie differently, rather than constantly baking a bigger one, is long gone.

You know, recently my partner Gabrielle Hecht has been focusing her work on trash. She comes home with these unbelievably depressing statistics about things like microplastics. Plastic bags and containers disintegrate into tiny particles, and then they're in our food, in the water, in the air. You eat them every day. They're in the sea; they're in practically every organism on the face of the earth. And we have no idea how that affects life, or human beings, in the long term. And there are so many other ways in which we send out our waste all over the planet, and we're altering it irrevocably in the process.

**Alexander Monea:**

When you speak about being faced with such scientific knowledge and being left depressed and apathetic, unable to act and to do the same justice to a discourse on the self as you did in *The Closed World*, do you think that is in part because there isn't anywhere to look at the moment to figure out what the subjectivation schema or discourse on the self might be? Is it because it just hasn't congealed or crystallized yet? It would seem as if there are myriad examples of people trying to develop just such a discourse in relation to climate data and models, such as eat-local movements, zero-impact living, or even eco-terrorism. While these individual compartments and dispositions have obviously not been enough to change the globe, would you not still understand them as subjectivations corresponding to climate science as a discourse?

**Paul N. Edwards:**

Yeah, so here's an interesting thing. Earlier today, I was talking about last week's rollout of the U.S. government's climate data portal, which they presented as relevant to human health. At the White House rollout event, one presenter was from a company called Quantified Self. His idea was we've got all these people who are becoming obsessed with data about themselves. Mostly what that means is health data: heart rate, calorie intake, hours of sleep, and things like that. So his idea was, what if we could reconceive data about the self to include not only what happens inside your skin, but also what happens around you, your environment. Maybe you would get interested in your own climate and how changes in that affect your body, your weight, your mood, or your productivity. I didn't quite buy that, because I think it's too small a scale, too local to really work. For one thing, the human time scale is hours, days, weeks, but the climate time scale is seasons, decades, centuries; very few people are going to stay with it long enough to track changes on those time scales. For another, the environment (in that sense) isn't something individuals can change; we experience it as a context, not something subject to our control, except through yet more technology: buildings, air conditioners, lighting, and so on. So keeping data about its effects on you doesn't seem likely to lead to action on environmental problems. Still, weather—which does occur on the human time scale—affects everything I mentioned, and that would certainly be of interest. And maybe people would get interested in tracking their waste, how much they recycle or reuse, and so on. So I could see where he was going with that. I can imagine a perspective on the quantified self that would bring your relationship with your environment into focus. As I said, part of the problem with that perspective is that—in our part of the world at least—we're so easily able to control our surroundings. We make our own environments, so we don't really live in the green world very much. So we lose track of it.

**Alexander Monea:**

Or perhaps the American self would be like Galison's tourist of trash and waste from today's presentation. [Laughter]

For me this is a particularly interesting question—one I come back to whenever I read about climate change, or really any issue that is similarly global and systemic. What sort of agency does one have? How do you engage with the problem or comport yourself toward it in any sort of meaningful way? The big question I take away from *A Vast Machine* is: What are the points of intervention? Should I drop out of graduate school and work on producing better climate metadata in hopes of contributing to the production of climate models? What are the appropriate responses to reading about the issue of climate change, its scientific articulation, and its stakes for humankind?

**Paul N. Edwards:**

My political coming of age was in the late 1960s and the 1970s. At that time a lot of us had the sense that you could make a big difference. You and your little group could really matter in the world. Go to protests, write letters to the president and Congress, do consciousness raising. Correct your own behavior and speak out, and the world would change. To me, the climate change case, the Anthropocene era, are just not really like that. They're not individual behavior problems; they're system problems. Individual behavior enters into it, of course, but even if everybody worked as hard as they could to reduce their own energy consumption and waste production, we'd still have the climate change issue, because it's the basis of our global energy economy. And in any case, environmentalism in that 1970s sense has been sidelined

as just one more individual preference; in American politics, it's seen as just one more interest group among others. Which makes it, once again, a matter of individual choice—and one that most people are not choosing. So, yes, do your best, but in the long run—actually in the medium or even the short run—we have to get off fossil fuel altogether, or almost all. Leave it in the ground.

Another huge element is all these animals we raise—especially cattle, but all the others, too. According to Vaclav Smil, 10,000 years ago, 99% of the world's zoomass (animal biomass) was wild animals. Today, 98% of zoomass is people and the animals we raise. About one-third of the earth's land is used to raise animals, and they consume half or more of the world's grain production. We also burn a lot of fossil fuel and use a lot of water to raise those animals. And they create huge amounts of greenhouse gases—especially methane—just by eating, belching farting, and shitting. And yet most people who eat meat are not going to stop doing that, at least not completely.

So I think the big danger in climate politics is the tendency to make it into a moral problem for individuals. It isn't really that. It's about these much bigger systems that we're all part of. Yes, absolutely, we should all eat less meat, drive less, ride bikes, and fly less. But if that's where your politics starts and ends, you aren't going to even come close to solving these problems—and even worse, you'll find yourself stuck in with the Achilles heel of American politics, namely that behaving responsibly should be a matter of choice. These problems go much deeper than individual behavior. As for solutions, the levers we have in the global capitalist system are basically all financial. And if you can't tax carbon, you can't drive the price of fossil fuels high enough that it becomes thinkable to leave them in the ground. Our best hope, for now, is nations like Germany and China, which still have collectivist politics. They're taking the climate threat seriously and moving to completely revise their energy systems. But they can't do it alone.

**Alexander Monea:**

I think on that note we'll end, and either understand it as the whimper with which the world ends or a call for person(s) of vision to render an appropriate response seeable and sayable.

**References**

- Edwards, P. N. (1996). *The closed world: Computers and the politics of discourse in Cold War America*. Cambridge, MA: MIT Press.
- Edwards, P. N. (2010). *A vast machine: Computer models, climate data, and the politics of global warming*. Cambridge, MA: MIT Press.