# Bio-History in the Anthropocene: Interdisciplinary Study on the Past and Present of Human Life

Kyle Harper, University of Oklahoma; Lynn K. Nyhart, University of Wisconsin-Madison; Joanna Radin, Yale University; Julia A. Thomas, University of Notre Dame; Russell H. Tuttle, University of Chicago; Jonathan Lyon (moderator), University of Chicago

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Panelists:

**Kyle Harper** (University of Oklahoma) is a Professor of Classics and Letters. He studies social, economic and ecological history of the antiquity and the Middle Ages. He is the author of *Slavery in the Late Roman World, AD 275-425* (2011) and *From Shame to Sin: The Christian Transformation of Sexual Morality* (2013). He is also the founding director of the Institute for the American Constitutional Heritage.

**Lynn K. Nyhart** (University of Wisconsin-Madison) is the Vilas-Bablitch-Kelch Distinguished Achievement Professor in the History of Science. Professor Nyhart is known for her work in the history of biology: natural history and evolution, anatomy and physiology, ecology and marine science, as well as relations between elite and popular science. She is the author of *Modern Nature: The Rise of the Biological Perspective in Germany* (2009) and served as the president of the History of Science Society.

**Joanna Radin** (Yale University) is an Assistant Professor of History and History of Science and Medicine. She is a historian of science whose interests and expertise encompass the history of biology, medicine, anthropology, biomedical technology and global health. Her research examines the social and technical conditions of possibility for the systems of biomedicine and biotechnology that we live with today.

**Julia A. Thomas** (University of Notre Dame) is an Associate Professor of History who specializes in environmental and Japanese history. Professor Thomas investigates the concepts of nature in Japanese political ideology, the impact of the climate crisis on historiography, and photography as a political practice. She is the author of the award-winning *Reconfiguring Modernity: Concepts of Nature in Japanese Political Ideology* (2001), and the essay "Photography, National Identity, and the 'Cataract of Times:' Wartime Images and the Case of Japan."

**Russell H. Tuttle** (University of Chicago) is an active Professor of Anthropology, Evolutionary Biology, History of Science and Medicine and the College at the University of Chicago. Professor Tuttle is one of the leading figures in the field of evolutionary biology, and is known for his pioneering discoveries, extensive field work, and countless undergraduates and graduates he has mentored in the past fifty years. He served as the Editor-in-Chief of the *International Journal of Primatology* and the book series *Developments in Primatology: Progress and Prospects*.

Moderator:

**Jonathan Lyon** (University of Chicago) is an Associate Professor of Medieval History and the College. He studies medieval European political and social history and the history of the family. He is the author of *Princely Brothers and Sisters: The Sibling Bond in German Politics, 1100–1250* (2013).

**Jonathan Lyon:** Welcome to "Bio-History in the Anthropocene: Interdisciplinary Studies on the Past and Present of Human Life." Our speakers will have five to ten minutes to briefly address two broad questions: How has your research crossed the boundary of disciplines, such as biology, history, and anthropology, to gain new insights on the past? And what do you consider to be the greatest challenge and opportunity that modern biological sciences present to social scientists, and how could social inquiry in turn inform and influence the development of natural science?

**Julia A. Thomas**: Thank you. Today I would like to talk about history and biology. I spend a great deal of time wondering what it is that historians do. And as I begin to think about this question, I look back at a man named Jean Bodin, who wrote a book informing us that we could do history very easily: *Method for the Easy Comprehension of History*, which sounds great to me. And when you read this very interesting book published in 1555, he says that of history—that is, true narration—there are three types: natural, human, and divine. And natural history he calls inevitable, human history he calls probable, and divine history he calls holy. So, I'm going to set aside the holy here, and look at this notion that there is natural history versus probable human history, and where those lines of thoughts have gone. And I think they have guided us for many centuries. Now, perhaps this guidance is leading us astray. Because I think for a long time historians really took this idea to heart. What we did was to separate from nature. We were interested in tracing the story of liberty, which is what Benedetto Croce

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calls history. History is the story of liberty, so we didn't want to have deterministic processes. We were interested in the idea of probability, which left open the room for free will and judgment. And that's what made history a political practice, and that's why we did history. And whatever the scientists did, since I wasn't a historian of science and I didn't have any idea really, they did it at the other end of the campus. And that was safe, and nice, and we've been trundling along in this way for a long, long time.

But of course, things have changed. Now we are discovering that we can no longer separate nature and humanities in this neat way. And that in fact, our species is transforming the planet in extraordinary ways, that is now producing an age that the geostratigraphers are beginning to refer to as the "Anthropocene." Indeed, on August 29, in Cape Town, they just voted to move forward with making that new geological age a formal proposition, to bring the evidence before their various voting boards. Do all of you know that term, the "Anthropocene"?

Obviously, what this term suggests is that the human species is now transforming the natural processes on this planet to the extent that it is no longer as it once was. It is as hot now as it was 115,000 years ago. That is a very long time. We have also transformed the planetary system regarding nitrogen and phosphorous, not just the climate-changing gases like carbon and methane. And I won't through that whole litany.

But what this suggests is that humanity and nature are coming together. And this has got historians very excited. We are beginning to think about things like neuro-history, which is what Dan Smail talked about when he was here at the University of Chicago—he's also talked about it at other places. Ian Morris has announced that history is a subset of biology, which is a subset of chemistry, which is a subset of physics. Edward Wilson has said that we could have consilience, so that history and nature come together. And in fact, the title of this panel today is "Bio-History", as though those could be brought together. And I'm not so sure about that. I have real questions about whether it is possible to describe reality in all its many facets in one way, which incorporates all the many forms of understanding we have developed over the centuries.

And let me tell you what I do to explore this question. I decided to look at three kinds of biology, and ask what sort of human being they produce, and then look at the kind of human being that emerges through historical practice. I first looked at paleobiology. So, I was looking at the great span of human existence, and it turns out that lots of people have done this, and that we can be seen as a species operating across the face of the planet. Some paleoclimatologists are beginning to say things like: yes, indeed human beings are changing the planet, they're warming it up, and we've in fact delayed the next ice age, which was previously scheduled for 50,000 years from now. And this is a great thing, because now the next ice age won't come until 133,000 years from now. This actually means that climate change and warming are a good thing, because human beings will probably be able to survive much warmer climates much better than they would another ice age. And of course, it all depends on how you define "survive," or "just fine," or what it means to be human. But we're getting that kind of image of human being out of paleoclimatology and paleobiology, and that's really interesting to me. What would it mean to be thinking of ourselves as species operating over hundreds of thousands of years? What does that mean for who we are and what our values are?

I also looked at two other forms of biology. One of those was about the microbiome, which of course we're all reading a lot about these days. And it suggests that, if not ninety percent of our cells, then close to sixty percent of our cells, are not human cells but those of various bacteria. So, in fact we are not single organisms, or single species, but multi-species organisms. That's a very interesting way of thinking of the human. But that suggests then that we are not a single species but many species operating together, and the question becomes one of human solidarity. Because although all my human cells and your human cells are quite alike, our microbiomes may be quite different. So, are we really the same species? —which says all kinds of awkward things for human solidarity.

I also looked at toxicology, and the kinds of chemicals in the human body that are making us now not just biological but also chemical in various alarming ways. It used to be that we were able to separate out chemicals from ourselves, and those of us that were poisoned by chemicals often suffered a great deal, but there was a sense of the rest of us being ok. It turns out now that since the Second World War, we have had more than 60,000 new chemicals developed, and the FDA has only tested 200 to 300 of those, and not in combination. So, we have no idea what this toxic soup we swim in is doing to us, although the American Chamber of Commerce tells us that this is actually just fine, and that we can survive this as well.

So, what I'm suggesting here is that biology doesn't give us just one form of humanity that historians should then look at, but *biologies* give us many forms of humanity that are quite different from what we in history have thought of as the human.

The question, then, to get to the second part of this talk, is how we go forward and focus on human history as we have been doing, and still do it in a way that is attentive to the actions that are central, it seems to me, to the historical practice? These are questions of evaluation and articulation—of what it is that matters in human life, not just what is in human life.

It thus seems to me that as we join hands with biologists to try to describe the human being in ways that are more embodied than previous generations of historians could give, we are dealing with incommensurate views of the human. So, what I'm trying to do now in my work is to figure out how we might think of ourselves as embodied, and as a species,

and still be true to the political calling and history as a story of liberty.

**Joanna Radin:** Thank you Julia, and thank you for the organizers for inviting me. It really is genuinely exciting to be here, especially because of what had not been able to be in my biography until this week: I have completed a book on this subject, and it will be out this March from the University of Chicago Press. The book is called *Life on Ice: A History of New Uses for Cold Blood*, which grows out of research that I've been doing for some time on archives made not of manuscripts, but of human bodies.

So, in the way that Julia asked the question of liberty, I'd like to talk about justice and have that be the anchoring point in what I want to say. In thinking about how to prepare my comments, what I think might be easiest to do, through tracking my disciplinary commitments, is to do it a little bit biographically, or from a perspective of craft ask: how does one come to a history of biology that has a freezer at its core?

This research journey began when I worked in public health, where I started out before I became a historian—I was working for the CDC, Centers for HIV, STDs, and TB, dealing with their large-scale databases in the early years of the millennia, and trying to make sense of how messages about risk and sexually transmitted infections got created. And it was spending time with the epidemiological data that I started to ask: why do we know this? And how do we know this? And why did we collect data about x and not about y? And how come the messages that I've received have not been the messages that other people have received? Why were the public health messages about HIV in this country uniform, even though we had evidence that people experienced the illness differently in different communities?

That was what led me to try to go back and get a PhD in the History and Sociology of Science, which I did at the University of Pennsylvania. And that was the same year that National Geographic's Genographic Poject was launched. This was an effort to sample and archive human diversity to track *man*'s journey. We can set aside the gendered issues, since *man* is at the center of a lot of this. But what I found fascinating about this project was not only the effort to tell humanity's deep history—where "we really came from"—but that it had a public participation component where people could send in a swab of your cheek and find out where *you* came from. I was interested in how is *we*, humanity, and *you*, not the same?

I started scratching at that question and it drew blood. Specifically, it drew blood of people whose bodies were purportedly going to help me understand who I was, but who were not me. These were blood samples from indigenous people around the world who were cast as vanishing or disappearing. And I got interested in why these bodies and DNA were part of *my* history. So, digging into the history of why these blood samples came to be collected led me to an earlier project called the Human Genome Diversity Project (HGDP) from the 1990s. When the Human Genome Project was created, DNA was collected from only a small number of people, so the "human genome" was only the genome of a few. So, some scientists argued that we needed to represent more of humanity's diversity in this project, let's sample the DNA of peoples who are vanishing—who represent "our" evolutionary history--in order to construct this. The project was derailed due to a pan-indigenous movement that said, "Wait a minute, what are you going to do with these samples? Are you going to make money off of these bodies?"

And the project faltered. It didn't achieve the impact that it wanted. But this turned out to be not historical enough, so I had to go back to an earlier iteration called the International Biological Program (IBP), which ran from 1964 to 1974. It was a large-scale project to sample and archive all types of biological materials, and in particular, it had a section on Human Adaptability, which involved sampling and archiving the blood from indigenous peoples who were disappearing.

And so, I've told this story in reverse. There is a recreation of the indigenous person that seems to be ever disappearing (we could go back centuries), but this is where I decided to start my history—in the immediate postwar period. Along with the bomb, it was a moment of reckoning with how the planet had changed, and how the nuclear era had brought new kinds of risks that could only be measured over very long periods of time. People had detonated the bomb, but it was unclear as to what effects this would have. Some of the scientists who were very active in the project, including one called James V. Neel, who was a very influential human geneticist, were working in Japan on the Atomic Bomb Casualty Commission (ABCC), looking at the survivors of Hiroshima and Nagasaki as a kind of "natural laboratory" on the effects of radiation. And it was around this time that Neel became interested in seeking out humans that he imagined as untouched by modernity, people who could serve as controls, who were baselines, to use the language of the time. This led him into the Amazon and to working with groups that he viewed as pristine and optimally adapted to an environment in which they had purportedly lived for millennia.

It wasn't an explicitly racial program, for it was supposed to be a moment of moving past race. After all, this was the period of the new physical anthropology, a time when we would move from racial categories to populational thinking: there were no races, only climes. And there was a sense in which, by dividing human communities into "Stone Age" and "Atomic Age," they, as cosmopolitan civilized scientists, would be able to track the extent to which they and other members of their societies had become maladapted to a techno-scientific world. Scientists collecting blood in the fifties and sixties did so from around the world. What enabled them to do this? This is the first time that they could collect blood and store it at low temperature, in a biodynamic state.

So, when I went into the archive I thought I would be looking for certain kinds of things about human difference and human history, but lo and behold, in all the archives, there are anxieties about the freezer: the freezer will serve as a time machine; the freezer will allow us to suspend animation; the freezer will let us to save this priceless resource and have it for the future as yet unknown. Biological anthropologists working with the administrative infrastructure of the newly created World Health Organization (WHO) created a massive tissue-based infrastructure to get these materials from the most "remote" regions—remote from such places as Cambridge, MA, so it is a matter of perspective—and bring them back to their labs, where they could become literal human resources, serving as a resource for the future. I should point out also that in this period no one was talking explicitly about DNA. Nobody said that we were going to sequence the DNA. People were looking at serum, protein variants, looking for immunological history and blood groups. But it turns out that the ability to preserve the materials into the present and future allowed them to be mined for purposes that were unanticipated at the time. Now this is considered by many to be a remarkable success.

What are these being used for? When HIV became an epidemic or pandemic, scientists went to these freezers. It was in these freezers scientists found the first evidence of HIV-1 from blood collected somewhere near the Congo in 1959. In part, the blood had been collected not for HIV—no one was talking about it then—but for blood group research. Now there have been studies of flu and the Great Influenza epidemic of 1918-19. The thought has been that if we can get blood from people who have immunological signatures of these viruses, maybe we can understand why they were so deadly. And most dramatically, when I spent time in a biological anthropology lab, where I was learning how biological anthropologists were using this old blood to ask historical questions, I was fascinated that they were actually not especially interested in the human. Although I thought that in such a lab we would be talking about human variation, these scientists were in fact more interested in what was called "Mosquito Anthropology," because it turned out that some of these blood samples that were collected in the fifties and sixties contained malaria, whole plasmodia that hadn't developed drug resistance—organisms that can't be found today. The idea was that if you could go back and understand this early malaria, uninfected by modernity so to speak, you could rejigger the structure of chloroquine, heal the world and save the world.

And maybe you can. They haven't done it yet. But it was that kind of research that fascinated me. To see efforts to discover whole biomes within these human blood samples that were collected for one purpose, that continued to reveal and unfold their as yet unknown story. This sounds great and is exciting to learn. However, here is where justice comes in, and what I consider to be one of the greatest challenges.

It turns out, and it would not come as a surprise to any one of you in this room, that indigenous peoples have not disappeared, and in fact, more and more are claiming indigenous identity. And certain groups of indigenous people want their blood back. They argue that although many of them agreed to participate in these studies at various points in time, they didn't agree to have their blood stored for reasons that no one could have known about. There have been several high-profile cases of repatriation, including of samples collected by Jim Neel in the sixties. They just went back this spring to members of the Yanomami on the Brazil-Venezuela border. And there are other members of the community saying, "We want to know why these samples are persisting, and who is getting to define the questions." So, these are where the questions of justice come in.

What I wanted to highlight in my research is that this isn't a question of science versus religion, science versus history, biology versus history, or anti-science versus pro-science. Instead, this is about what gets to count as an object for science, whose bodies are the materials upon which knowledge of what it means to be human is generated, and how we should think of research questions that get asked when the human is the object, subject, and research material of study. What does it mean to ask research questions that benefit the widest array of lives? We see new innovations being made related to indigenous genomics, science, and justice, especially efforts to enroll research subjects at the beginning of research, asking: what would you like to know? This has been a big challenge in the realm of consent. What does it mean to grant consent to something when the future use is unknown?

Therefore, the most important questions that I'm struggling with and working towards in my research is to write a history of science and a history of these practices to help all the various groups who have a stake in these projects understand the circumstances that have brought them together. In the service of asking new questions, I think there is enormous potential for historians and biologists to share their knowledge practices. Samples that may not have been intended for *me* to write about have made me think really differently of my obligations as a historian, of whose histories I want to tell, and what kind of histories serve which kinds of audiences.

**Lynn K. Nyhart:** When we think of the different entanglements of biology and history, the one I work on is pretty straightforward. I use the methods of history to study ideas about nature by people we call biologists. I mostly work on the nineteenth and early twentieth centuries, mostly on Germany, but my teaching comes up to the present. So, the challenges and opportunities that I want to talk about have to do with some present-day things.

In my recent work, I focus on two things: how scientists before Darwin thought about the transformation of species—and I might come back to this topic in my later discussions on challenges and opportunities—and also, as was mentioned in the introduction, the circulation of ideas between the realms of the

social and the biological, particularly in the organization of nature and of society. So, for example, the notion of the division of labor, as is well known, comes out of political economy and was transferred into physiology to talk about the physiological division of labor in the early nineteenth century. It was then re-exported back in lots of different ways into social theory in the later nineteenth century and put back into politics, too. Interestingly, those moves in both directions were pretty non-controversial. The idea of division of labor is so completely naturalized into the vocabulary of science that nobody ever thinks of it as a term of "political economy" about five minutes after it happens. By contrast, ideas about how an organism is governed are much more contentious, and remain so throughout the nineteenth century. Increasingly, there is an effort to use models of nature as the model of the state. And the question of whether a state is an organism, or in what way the state is like an organism and therefore should be subject to the same kinds of analyses, is something I'm very interested in. Maybe in the discussion, if people are interested, I can tell you fun stories about the satirical work that I've read from the radical zoologist, Karl Vogt, who both participated in political activism and worked on problems about animal societies and organismality.

But what I really want to talk about today are current challenges presented to historians and all of us by biology. And the one I picked actually has to do with the big speed-up of genomic manipulation allowed by new techniques like CRISPR-Cas9. How many people have heard of CRISPR in the room? This is a technique that allows scientists to cut and paste bits of genome in ways that are much more efficient and accurate than they had been before. And that will likely result eventually in pretty good changes in organisms that we have introduced. So, when people talk about the Anthropocene, they don't talk about this, but I see it as a piece of the same thing. For these are ways in which we are fundamentally changing our biological surroundings, or about to be able to.

So how is this a challenge for historians? Well, before we do that, I forgot to mention the Zika issue. How interesting it is! If you have a hammer, everything looks like a nail. If you have CRISPR, then you think: can we create something so that, if you just put in a few mosquitoes, it will cause them to reproduce this feature to the extent that, eventually, malaria- and Zika-carrying mosquitoes will just die out? Sounds like a good idea, though those mosquitoes are pretty rotten things. What will that do ecologically? What will that do evolutionarily? These are pretty hard to know right now.

CRISPR is also one of the tools being used to reconstruct extinct organisms. For example, there's a big project to reconstruct the passenger pigeon. Another famous and interesting and quixotic project aims to create and to engineer a very large hairy elephant that's going to be mammoth-like (because you can't actually reconstruct a mammoth, but you can get close, maybe). Fortunately, velociraptor DNA are really too decayed to be reconstructable. And then of course there's the spectre of human germline editing as well, which could mean changing what in *us* gets passed on to the next generation—and we might again think about which "us" we mean.

So how does this present a challenge for us as historians? Well, one of the challenges is that new history is being written about this already. Most famously, in the case of CRISPR there was an article in an issue of *Cell* last January which appears to credit a lot of different people for their contributions to the CRISPR technique, but which conspicuously omitted the two people who happened to be women, and who were also engaged in a patent dispute with the institute run by the author of this article. So, you can imagine the layers of objections that zipped through the blogosphere in the week after this amazing article came out. This also, of course, represents an opportunity for historians. We can watch participant histories in the making, and we can see how they are involved in the telling of their history. It's different from, say, if you work on the early nineteenth century as I do, in which case all of your actors are dead. Then of course they can't disagree with your interpretation, which is nice. It's also easy to forget all of the things that surrounded their version of history during its making. And I think seeing that happening now gives us a sense of how these future primary sources are constructed in the first place.

And then we still have the opportunity to put them in longer trajectories. One of my favorite things to do in my teaching, and the reason that I always bring my history of biology course up to the present, is that the present is always changing, and it always changes what the history is that I teach every year. Because even those same stories feel different if they end up in a different place. So, we can do that with CRISPR as well. We can connect it up with longer histories of genetic manipulation. We can connect it up with longer histories about eugenics. We can connect it up with the history of patenting. We could connect it up with the history of globalization, which after all is a story that's been going on for many hundreds of years.

How in turn might historical inquiry inform and influence the development of biology? I think the way that I want to answer that is to suggest that it's about getting budding biologists to think more broadly about their science and its social aspects, and to make those things part of the doing of biology as well. Let me just give this example. I was at a talk last week about creating international policies to regulate human genome editing, and about the problem of getting public input into those policies. Everyone says there should be public engagement. But it's very hard to figure out how to get it, and how to get people interested. Because if it's not affecting you immediately, it's hard to be involved.

So, here's where the historians and other humanists might enter. There are lots of possible futures here that we could imagine. And scientists aren't well trained to imagine those kinds of possibilities. Bioethicists tend to be caught up with legal and philosophical issues, and sociologists generally work in the

now. But there's also a very long history of imaginative thought about the future of society as manipulated by biology. And I think it would pay us all, not as social scientists so much but as humanists, to look back at that history and think about how people have imagined the future based on social and scientific manipulation of human bodies. So you can think of writers from Nathaniel Hawthorne to H. G. Wells and Andrew Niccol, who was the writer and director of *Gattaca*, to somebody like Scott Westerfeld, whom some of you may be familiar with, just to name a few. I think situating those works historically and getting scientists to read that kind of writing from a broader perspective is one way to expand the imagination and ways of thinking about what should be involved in doing biology. I also think that it offers some greater hope, maybe, for different imaginative futures than the scary ones that we see represented.

So, I guess, if Julia's keyword was liberty, and Joanna's was justice, mine might be imagination.

**Russell H. Tuttle:** I am a four-field trained anthropologist from Berkeley: linguistics, archaeology, sociocultural anthropology and biological anthropology. I chose to be more biological than anything else, which is why I'm connected to a number of biological groups at the University of Chicago.

History is probably the most important endeavor by which humans can try to expand their education, particularly the history of whatever project one is conducting. I mean deep history going as far back as possible. Often, you will find that things have already been said, etc. The great tragedy of our species is we don't learn from history. Current events now confirm this. And we are capable of much better. People who are highly educated in the best universities in the world seem to forget a lot of their history when they get in power. They keep repeating the same old things. Not being a formally trained historian, I am freer to say what I want about events and persons of the past. I don't have to follow the current practice or the older practices of historians. For instance, should one blame eminent people from other eras for the mistakes and the problems they cause for people right now? I think we should, especially if they continue to be sources of harm to current and future generations.

I'm aware of Darwin's contributions to changing the world, probably making it seem more about nature. But I am also aware that he was racist, sexist, elitist and classist. He invested his inherited fortune in railroads at the outset of the Anthropocene in the 19th century. Anthropocene is a very current concept. It's useful, but it's heavily based on technological innovation and change, and we have people today who protest about how it's affecting nature and justice and many other things, which is a very worthy enterprise.

Some aspects of the talks that I've heard evidence a phenomenon called emergence, for which I will give a simpler example. Hydrogen has its properties; oxygen has its properties. When you put them together you get water, which has very different properties from either. Humans are recurrently emergent. We are a distinct species. The entities that people hypothesize—in some case demonstrate—are made up of chemical components and many other factors of various kinds bound together. Yet we're incredibly similar to one another. It is fashionable to say we're 98% chimpanzee so we're just another chimpanzee. This is entertaining as cocktail party conversation. But we are in fact quite different from the apes, especially behaviorally. I like to think that we live in a novel niche—call it the Anthropocene, if you wish, though it extends much further back in time. Our niche is very different from that of any ape. Indeed, available genomic samples of wild chimpanzees show that there is more genomic variation in one community of about 100 to 120 chimpanzees than in all of humanity. They all know each other to some extent, and they come and go in different subgroups. But they do not evidence the myriad variety of emergents that humans have exhibited and will undoubtedly continue to display.

Nonetheless, humans are also incredibly similar. Superficial things that you see, can be sorted out. Genomics helped to debunk the idea of human biological races. Global travelers see clines of phenotypic variation, generally gradual variations in traits that do not cluster enough to bound populations. The problem with human genome projects is that they were spot sampled. If you put a grid over the globe, especially some years ago, and went from point to point at regular intervals, you would not get variations of traits that would all come together in clusters evidencing that people are significantly different from others.

To the second part of the question, I think one of the things that biologists and social scientists should combine to do is get totally rid of the biological race of human beings. It has no place in our societies. The 2020 census is going to be changed, hopefully they're going to stop "white" from being a meaningful category. Note that the 2010 census form has no selections after "white" that specifically say what your white group is. Of course, if you're darker skinned, they're very interested in what that means and kinds of "black" are proffered. Current groups are actually statistical races, often determined by the doctor or loan officer or schoolteacher, minister et al. listing you by your physical appearance, which can be very misleading. And they can also lead to harmful decisions. Many medical researchers, and other kinds of researchers, must report their samples by race. Sometimes in their papers in the PNAS or specialty journals, they can write as if they didn't really conduct the study with regard to race, but they usually have to report it that way, if they're going to get government grants. Our country is much too preoccupied with race, especially given that it is merely a biologically unfounded belief system. I've complained at the hospital and other institutions for years: don't put me down as white for race and ethnicity. I've never checked white on a census. I'm a mongrel!

In fact, in terms of ancestor tracing, you can trace your ancestry, if you have written genealogies or other records, but otherwise forget it, because you don't know really that you have the

DNA of people 300 years ago, of somebody you might see the name of, because it keeps changing. It changes through generations. Because of the way it works reproductively, a lot gets left out from each parent. For those of you who are into binge-drinking, stop it: it can alter your DNA according to a recent study, and you'll pass that damaged DNA off to your children, so think of the future. Healthy kids are challenging enough. My chief take-home message: get rid of race.

Kenneth Prewitt, who was with our political science department, wrote a book called *What is Your Race? The Census and Our Flawed Efforts to Classify Americans* (2014). Apparently, he tried to get some amendments when he was head of the census, but he didn't get very far. They simply wouldn't listen to him. His prediction over the next several generations is that the problem will work itself out because society is changing. But do you see us becoming more and more post-racial? I think not. Politicos are going to find some use for it. And it has to go back to biology, because that's how ignorant people identify people: by how one looks. It's their way of justifying us versus them, which came up in one of the talks here.

As to genetic modification, especially in the food we eat. Humans have engaged in selection for millennia —ever since domestication came along. It's called artificial selection as opposed to natural selection, but we've been selecting for what we want in terms of traits for a very long time, so maybe going in and snipping and crisping up this and that might not be harmful to consumers.

Another point I'd like to make is that biologists need a lot more social science—history and anthropology, especially. Many biologists don't study whole organisms. Organismal biology is passé. Genomics is all we are supposed to need. Yet the science is really in very early stages of development. To the extent that you actually can read a human genome for physical or behavioral traits we are off to a slow start.

E. O. Wilson was mentioned here. I have great regard for him in many ways, but… he is the founder of sociobiology, now called evolutionary psychology because sociobiology fell into disrepute. It seems now the key concept of kin selection (a special form of inclusive fitness), in which from time immemorial close kin groups that were key to survival of a species doesn't work for humans. The regression formula that was supposed to be predictive isn't. They found this out a few years ago. Wilson has a new book, actually an essay, called *The Meaning of Human Existence* (2015). It's a reiteration of jumping from ant biology to human beings. While he dabbles in humanities along the way, he skips over the social sciences. When Wilson, to his credit, discovered that the regression formula for inclusive fitness doesn't work he and his colleagues wrote a paper that finally got published. But Richard Dawkins got 50 other eminent people to sign a petition to block its publication. Kin selection theory, which prevailed in scientific circles for 50 years, did not serve humanity So if you want a project on social justice, here's one to trace historically.

It's interesting how people accept an idea and won't let go of it and whole schools, develop around it. We know that inclusive fitness and kin selection do not and probably never did operate historically. In apes, if a key member of a small group dies in an accident or by contacting a virulent disease how do you replace her or him? Does the whole group die off because they lost this member? No, you have to have some mechanism to replace them. That requires sharing resources and cooperating with one another, to an extent, which has been characterized human groups as far as we can tell, and still is with certain hunter-gatherers. Further, now that we can identify the DNA of group members among apes, there are usually fewer close kin than kin.

**Kyle Harper:** I'd like to start by reiterating my gratitude to the organizers and their great work. It's an honor to be joining this event, and I am really enthusiastic to talk about the ways that history and biology intersect. It's something that's become a passion of mine, and I thought I would approach the problem—my mind's been kind of blown by these really thought-provoking approaches to it—a little bit differently, which is to ask a specific question about a specific example of how an understanding of biology can help me in my workday practice of being a historian.

I'm really just a full historian who wishes he had been a biology PhD. It's too late once you get to a certain point, but you can still, whatever discipline you're in, try and be in conversation with other disciplines. I've found being in conversation with different parts of biology to be really informative, enlightening, helpful, and enriching, for solving some of the problems historians are interested in, like what causes historical societies to develop in certain ways. Specifically, I'm a Roman historian, and so I'm interested in things like: why has the Roman Empire become a huge political formation that stretches across three continents, stretches over massive parts of western Eurasia, the entire Mediterranean, from these really continental climates in Northern Europe to subtropical climates in southern Egypt? It's a pretty extraordinary political formation. I'm also interested in why it disintegrated—more poetically, more classically: why does the Roman Empire fall?

If we go back to the second century—the Roman Empire is at its absolute apex in the middle of the second century—it has 70 million people. That's a quarter of all human beings alive at the time. It is dominant over its neighbors, it has military hegemony. In fact, in 165 AD, in really just one year of campaigning it crushes the Parthian Empire in battle, which is probably along with Han China the other most sophisticated state at the time. So, the Roman Empire is this huge and very powerful political formation. The very same year that the Romans crushed the Parthians in 165 is the beginning of something that historians have long known and called the Antonine Plague, the eruption of a disease event that was really different from the kinds of disease events that the Roman Empire was familiar with. And the Roman Empire, of course, in the early first millennium, is

what we would maybe today characterize as an underdeveloped society: life expectancies in the Roman Empire are in the twenties, probably in the early twenties. Sometimes you go to Rome and you see the extraordinary monuments, and that can leave an impression of what the civilization's like, but by today's standards it's actually an underdeveloped economy with *very* high rates of mortality. And I would even argue—I am currently arguing—that it has a very, very bad disease ecology. That the endemic disease pool in the Roman Empire places a very high disease burden on its inhabitants, which is one reason why life expectancy is so low. I think it's important to ask what kinds of diseases caused these kinds of demographic outcomes, like low life expectancy.

I remember when I was, I think, out of graduate school and one or two years into being a faculty member (before I really turned to work on these kinds of questions), I asked a medical historian, "What do you think most people in the Roman Empire died of?" And he said probably just little diarrheas. And that was almost heartbreaking to me, because the Roman Empire this grand political formation, and its worst enemies were, you know, not even the glamorous super-killers like plague and ebola, but in fact really run-of-the-mill gastroenteric pathogens. That conversation actually planted this fascination in me—how did the Romans die? It led me to pay attention to all kinds of different aspects of what we know about mortality in the Roman Empire, and it really has helped me see that the plague that breaks out in the middle of the second century is really different—it's different in nature, it's different in scale—from anything the Romans had faced before.

We're unbelievably fortunate that one of the contemporaries of this plague was the second-century physician Galen, who's one of the most insightful, certainly one of the most prolific, ancient medical writers. He's a very good clinical observer, and his notes are very important for understanding this disease. And they have led most people who work on it to believe that the pathogenic agent of this disease event was smallpox. That in itself is tremendously interesting. I agree that it's smallpox; I actually think that until it's sequenced from an archaeological sample of a victim—which could be done, it's a double-stranded DNA virus, so it's theoretically possible (I know at least two labs that have tried. I don't think that they have samples from the second century, nobody has sequenced it yet)—I think that until we do this, we have to be open-minded about what the pathogenic agent of this disease event is. But it's probably smallpox, and it's estimated to have killed anywhere between two and fifty percent of the population of the entire Roman Empire, which I say to try to underscore the challenges of studying ancient disease events. It either killed a few million people or 30 or 35 million people. I argue that it probably is ten percent of the population. It's a huge disease event in scale. It strikes over three continents in the space of a couple of years, which is really extraordinary and requires a certain kind of pathogenic agent. It happens all across the Roman Empire.

And so, I approach this question, and say, what kind of event is this? Is this a historical event, or is this a biological event? I don't think you can *possibly* divide the two. It clearly is a historical event, in any way you want to define that; you have to be able to read Latin and Greek in order to begin to approach it, you have to understand inscriptions, you have to have a feeling, a finesse, for the cultural outlook of Galen to really understand what he's saying. So almost any way you define historical—you're interested in its causes and effects, what causes this plague to break out, what's the role of nutrition, what's the role of social formation, in fostering this outbreak—it's historical in its consequences. What happens when a society undergoes a smallpox pandemic? This is also a biological question, and here's what's really started to interest me, and the focus of my current work, because historians have sort of acted like: well, it was probably smallpox, now back to the historical questions. But I think that leaves out really the most important things.

The analogy I like to use is: if aliens came down from outer space and killed ten million humans, people wouldn't just say, "Ok, on to looking at the consequences." They'd say, "Wait a second. Who are these aliens, where did they come from, what kind of weapons did they have? How did they just kill seven, ten million people?" And we should be asking those same kinds of questions about the microbes that are responsible. The understanding of this event really requires some understanding of what the pathology of smallpox would have been, the medical dimensions of a smallpox infection, and, by extension, the epidemiological dimensions of a smallpox pandemic. Diseases can only do certain things depending on the biological properties of the pathogenic bacteria, the virus, and so on. They cause it. At the population level, those properties are studied as epidemiology. And trying to look at the Roman sources through an epidemiological lens—to say not just what is this virus doing to individuals who are victims of it, but what is it doing to the entire population?—I think are biological questions.

Then at even deeper levels, we should be asking: what are the ecological contexts for this kind of disease event, and ultimately what are the evolutionary contexts for this kind of disease event? I would argue (and I do argue in a forthcoming book) that this is actually the first appearance of the smallpox virus in the Roman Empire and Western Eurasia, and in fact this relies deeply on—specifically, we've been talking about genomic sequencing—phylogenetic evidence. It's now become apparent that the closest relatives of smallpox are other orthopoxviruses, like what is called taterapox virus, which infects this very cute little gerbil called the naked-soled gerbil that only lives in Central Africa and the savannas of Africa—that's its closest genetic relative. That's really important. The phylogenetic history of the orthopoxvirus family tells us a lot about how smallpox evolved, where it evolved, what its properties are, and what makes it like or unlike other kinds of viruses. And so, the knowledge that smallpox evolves very recently in the African savanna tells us, as historians, something. It tells us to look for: how did the Roman Empire connect to Africa? It turns out

simultaneously, by people totally uninterested in the history of disease, we've become aware of how connected the Roman Empire was through its commercial links with the east coast of Africa, the Indian Ocean world, with the ivory trade, with the gold trade, and with the slave trade. And to me there's a very strong case to be made that smallpox is a virus that evolves very recently, a few thousand years ago, in the savannas of Africa, and passes over the trade routes of the Red Sea or the Nile into the Roman Empire, and strikes the Roman Empire as a really emerging infectious disease.

And this is the final thought that I'll make. We live in a world where emerging infectious diseases are a huge issue. We've heard that Zika—I don't know if we've mentioned Ebola, SARS, MERS, HIV—all of these are emerging diseases. This means that they somehow sit at the intersection of evolution and human societies. And when that process starts is a great question, and most people who are studying emerging infectious diseases, most of that literature looks at the last hundred years. But in fact, emerging infectious diseases have a much longer time horizon. We've mentioned that if human domestication of animals inserts a kind of artificial selection, it also creates ecologies for the evolution of infectious diseases, and so many human diseases are of a zoonotic origin and have their origins around the time of agriculture, but not all of them. The Roman Empire sits as a part of a very long story of how humans have reshaped the global environment, in ways that create conditions for new pathogens to evolve, and then of course to establish themselves in human populations.

To me, maybe the most interesting thing about the Antonine Plague is that it's really the first appearance of smallpox in Eurasia. And what would have happened if the Roman Empire had not existed? If there hadn't been a major economy that was interested in extracting gold and ivory and slaves? Smallpox would have been an emerging infectious disease that none of us had ever heard of, because it would have not established itself, and it wouldn't have been one of the two or three most vicious killers in human history, down to its eradication in 1979. I think even to approach the kinds of problems that we might think of as most historical—like what caused the plague, how many people did it kill, what were its consequences—we can't even begin to separate them from what we might think of as traditional fields of biology, including ecology and evolution. So, that's my spiel, and I look forward to your questions.

**Lyon:** Thank you, all of you. That was breathtaking in scope, I have to say. Just a few notes to think about, then we'll see if you want to respond to each other, and then I'll open to the floor; we still have time. To give you a sense of the scope of what we discussed here, some of the fields and terms that I found myself writing down about the relationship between biology and history are terms like paleoclimatology, toxicology, public health, human genetics, pharmacology, human germline editing, the CRISPR technique, race, regression formulas, demographics, disease ecology, phylogenetics. Obviously raising questions about the relationship between biology and history lets us go in an awful lot of different directions. I don't know if anybody here wants to respond to anyone else on our panel—if there are any comments or questions for each other, or if you just want to throw the floor open?

**Tuttle:** I did want to think about smallpox for the sake of it. Most viruses I believe are rapidly changing, so the smallpox you might find—one wonders what happened. Did the people become immune? Were the survivors able to go on and have children to resist that strain of smallpox, and then it went into some other host and developed and then erupted again in more modern times? I don't know if the blood had smallpox bugs or not.

**Harper:** Great questions, and I think very open questions. The mortality of smallpox over the last 2000 years, down to its eradication, is so significant that it would be a candidate for something that could have exerted selection pressure on human populations, and vice versa certainly. But it's also easy to overstate the importance of inherited or other kinds of immunity; acquired immunity is always really, really important. I think one of the really big open questions in the history of disease will be: can we find ways that the history of disease has shaped human selection in recent times, particularly the immune system?

**Radin:** One of the reasons that the human geneticists that I was looking at were collecting all this blood in the fifties and sixties is that they were looking for evidence of natural selection. This was a resurgence of a neo-Darwinian paradigm. It was the era of human biogeography, and James Neel, in particular, was really convinced that he was, following a single exemplar of sickle cell anemia and its link to resistance of malaria, going to find the selective disease relationship for all of these different things. He used this argument to marshal evidence to collect all of this blood for selection, even though there was resistance from within the anthropological community. People like biological anthropologist Gabriel Lasker were like, "I'm not convinced." A neutral theory of selection was emerging, saying that we can't actually assert that all mutations are going to be the result of selection. And so even by the seventies this paradigm was falling apart a little bit. There was a lot of concern around selection and the kind of determinisms that could then be fed back into racial ideas of biology. So, I think this is an interesting tension, how do we take disease seriously, and these agents and entities seriously—not even as diseases, but as organisms in their own right, without falling into risks of reifying difference? So, it's an interesting conundrum.

**Thomas:** I'm very eager to hear what everyone else has to say, but I was very interested in what Lynn said about asking biologists to be conscious of their own practice, and how very difficult it is to be conscious of one's own practice, as historians and historians of science. And I wonder, Kyle, I know how exuberantly your work has been celebrated. And so, it's interesting to

me to see that, for instance, when malaria was proposed as the reason for the fall of Greece around 1900 with Malaria Jones, this was treated as an absolutely ridiculous idea. And yet now it's an acceptable idea, and I think this reflects on the kind of practices that we as historians do—that it is now possible to say these things without having rotten tomatoes thrown at you, which is a very good thing.

**Harper:** Sometimes I get rotten tomatoes thrown at me. No, I mean I think it's very interesting. Maybe I can briefly answer your question, and then pose it to the rest of the panel. I worry a lot about being accused of biological determinism, partly because I actually think determinism is a good thing. I want to know what determines what, and the role of biology as a causal factor in human history. What I never want to be called is a reductionist. So, I think biological determinism is a good thing, whereas biological reductionism is a bad thing. But I think it depends on what corner of the field I'm in—as a historian or a classicist. For some people, it's all biology, it's all kind of reductionist…

**Tuttle:** Which has minimal explanatory value.

**Harper:** Right, which has minimal explanatory value, for you'd be collapsing the real complexity and the real factors. But what do others think?

**Nyhart:** Well, I think the issue about determinism is really interesting. You mentioned agency, I think, and the question of freedom. If I had been answering this question about the greatest challenge of biology for historians in my first stab at this 20 years ago, I would have said biological determinism because of the rise of evolutionary psychology and sociobiology, and the challenge that that made, less to biologists than to a lot of people who enthusiastically took up evolutionary psychology and weren't paying a lot of attention to the biology. But that might be an overstatement. Even as I was writing that out, I thought, "Well, there are plenty of historians in the past who have also..."—I mean, let me go back. My concern about that is that individual agency gets squashed by biological determinism. But individual agency is also squashed by social- and economic-determinist historians, right? So, I'm just being a person who really wants to say individuals count.

**Tuttle**: I think economists have found that out. They have these wonderful models to explain human behavior, and then they find out that humans are not rational. We're not rational actors, we're suckers for almost anything. So, if you're going to look at any model, if any disciplined field proposes a model, be sure that you read the assumptions that are necessary for it to work. And usually if there are five assumptions, you'll be stopped at one or two, and you'll say, "That cannot be met." You know, it just can't. It simply won't work.

**Lyon:** Okay, why don't I throw the floor open? Let me just begin by saying in all honesty that as a college student–organized event, I do hope that all of the undergraduates in the audience will feel free to ask questions of the people you all have invited here. So, I hope everybody who does have a question feels free to ask it.

**Question:** Hi, all of you were talking a lot about biology and how it's very apparent that there is a lot of interplay between biology and humanity. I was wondering, because you brought up agency, what does history or anthropology or humanistic inquiry tell us we should do when we are shaping our world that we now have the power to shape? What should we strive for when we eventually end up editing the human genome, or we're deciding what species to eradicate? What should that tell us?

**Nyhart:** Can I just jump right in on that? Because this talk that I went to last week was by this guy who was working on the international policies about human genome editing. He works in a law school, and he took as the example some of his law students, who come to him, and they say, "I know my classmates are all doing enhancements to get their brains to work better. And I am not, but I feel disadvantaged." And he said, "You know, it's really true that people who can sleep fewer hours in a night and get more work done and cram more into their brains will get the better jobs. And it's true that, you know, that there's only a certain number of people who will get into the top 20 law firms." And I was just appalled by his acceptance of all the assumptions that went into that. I said, "Right, so if you want to select for the enhancement of the ability to sleep less and be more aggressive, that's something that we could choose, but let's not assume that everybody will pick that. What about if we chose to enhance for cooperation and kindness? Just for example. Maybe we would find that we would have a society that was, you know, more feminist (sorry) or something else!" But, you know, he kind of laughed when I said this because it was so absurd that anyone would select for this. So, I think as soon as you talk about that, what you are immediately talking about is, What values do you want a society to cherish? And that always comes back down to that. And so, as a humanist, tolerance, kindness, I mean those are values we need to know how to cherish and to enhance, and that's why I actually think some of the science fiction stuff, less the dystopian stuff...

**Radin:** I was just going to jump in on that. I've been teaching for the last two years a seminar at Yale that I call "Bio-Medical Futures," where we read...

**Nyhart:** I want your syllabus!

**Radin:** I'm happy to send it out to anyone who wants it because I'm interested in suggestions! What I'm kind of gambling on is this idea of imagination and thinking about these temporal possibilities, of biology and history, which also gives us a way to think about time travel in different kinds of ways. What would it mean to take science fiction, and not just contemporary science fiction, but historical science fiction, and put it

alongside science that was contemporaneous from the time? It has been a real experiment, but it's been very exciting because I have students, many of whom are from the sciences and engineering, and then we have history majors, artists and humanists. What's been interesting week after week is that there's this sense that the science sometimes seems a little bit more out there, the historical science, than the fiction. And what we keep coming back to, or what the students keep coming back to in the fiction, is the role of emotion. I thought they would want to argue the technical points, but they've become very interested in the ways that emotions guide us and ways of imagining how values in emotions play out when a new technology or innovation is made. So, I think—this is just to double down on Lynn's point—that this is a different way to think about how we can collectively imagine what the values of science are. What science fiction has been doing for a long time is destabilizing everyone's assumptions, so nobody gets to feel like the authority. And then there's this opportunity to come together around what is the affective response to these transformations. I mean, it's not even necessarily hard science fiction. A book that has been very affecting for my students is Kazuo Ishiguro's *Never Let Me Go* (2005), and that's a story that is very much about agency of clones who are made to be organ donors to another class of humans. The students ask, "Why don't they revolt?" And sometimes the question is, well, why don't you revolt? Why doesn't anybody revolt? You know? It's this question of agency, and do we realize we *have* choices and what *are* those choices? And how do you get outside certain kinds of assumptions? It's been a really exciting way to experiment, so I'm very open to suggestions, but I'd be happy to share the syllabus.

**Thomas:** I find your question very interesting, because it seems to suggest that we haven't articulated the reason for humanistic studies well enough recently. And one of the things that has interested me, the article from which I drew this talk, is called "History and Biology: the Age and the Anthropocene," which is part of a forum. And Kyle has a piece in it as well. At the end of this piece, I make an argument about what the humanities do, and what history does to articulate the kind of human being that we want to be, which echoes a lot of what Lynn just said, including a sense of humor. And it is amazing how people have quoted that. It was sort of this flag, and we're going down with the flag, waving in this deluge of science that seems to be overwhelming the humanities. But there has to be a way of saying what the humanities are for. And yet, I'm worried that we need to do a whole lot more of that, and to do it more convincingly and less apologetically. I don't know how to—I often find myself feeling as though we also need tolerance, kindness, as though these are somehow a sort of garnish. And they are not. They're central.

**Tuttle:** Do you consider history to be humanities or the social sciences?

**Thomas:** Well, you know, when I was here at the University of Chicago, it was both, but now I think it is just social sciences.

**Lyon:** It is, although that's unusual. There are plenty of schools and universities around the country where it's in the humanities. And it depends what type of history you are working with.

**Tuttle:** There is quite a growing group of very talented people, anthropologists and sociologists, who go into genomics laboratories, using ethnographic methods, if you will, to study them. They can be quite informative. They have to watch what they publish, I think. It's very interesting.

**Nyhart:** I was interested that the wording of the question, as it got shorter in the version that we got last night, changed, actually, to social sciences. Which, well, it's not exactly the same as it was before, and I had prepared my thinking and remarks assuming that history was in the humanities. Because although our history of science department is actually in all four areas [humanities, social sciences, biological sciences, physical sciences], any individual can choose to go up in any of those four areas for tenure. All of us who are in it—since I've been there, which is a long time now—have chosen to go up in the humanities.

**Lyon:** To quickly follow up, I was just thinking that, to a certain extent, despite your strong defense of humanities there, every one of you is talking about taking history in a direction *away* from the humanities. Or at least in the traditional way in which we understand historians doing the kind of reading of humanistic texts to understand the past. What you're talking about, many of you, is a heavy reliance on social science, natural science–types of techniques, which on the one hand is historians reaching out to engage with these things, but in the process, does history risk losing some of its humanistic qualities?

**Radin:** I think there's a lot of ways into that question, and what's interesting in this kind of parsing is what we call "objectivity." You know, that "noble dream" of the objectivity question: how do historians validate their knowledge? What was interesting to me, as I got deeper into that sort of humanistic historical practice that took scientists' works as its texts, was realizing that I was studying people who were creating and using an archive, and how remarkably little conversation there was about that in the history department that I joined— about what we might think of as the craft of history, or the evidentiary basis on which we make claims. And it's all about the footnotes, right, and what evidence you have. So, I think there are some interesting questions there, and that's what got me thinking differently about what it is that I am. What does it mean for me to make knowledge as a historian and to say I'm a humanist, and what are the ways we actually evaluate historical work and evidentiary claims that are there? So, that's maybe a whole other rabbit hole...

**Tuttle:** How will you conduct history in the future when everything's out in the cyberworld? When it's all in the cloud? There's nothing like going into old letters and things that people had written to pour over and read from...

**Nyhart:** Well, remember too, just conversely, things like Google and other digitization projects have made accessible to people a huge...I mean, I'm a Germanist; I can do most of my work now without going to Germany. It is amazing.

**Tuttle:** Let's hope it lasts; that is doesn't crash.

**Lyon:** Other questions, on science...?

**Question:** How do you convince biologists to introduce a historical perspective into their work?

**Radin:** I think you have to be willing to talk to them. So at least for me, I think there are big statements to be made and then there's a lot of personal work to be done—of actually wanting to approach things in a spirit of mutual curiosity. And so, that's hard to do, but...

**Question (rephrased):** Let me make it even more extreme—what have you done to convince biologists to put in a historical perspective on their work?

**Radin:** I can answer that. I don't know about me, but if any of you have other thoughts...

**Thomas:** One of the things I did specifically was, in thinking about the microbiome and working on that aspect of this project, to look at a study that had been done by five Korean scholars, who had looked at gut biota from the U.S., China, South Korea, and Japan, and then had carefully drawn a map where Japan is way outside of Korea, the United States, and China. And they labelled it by these countries. When you think of Northeast Asian politics at this moment in time, it's the map for the next war—or at least you can propose it for the next war—and you go to them and say, "Surely, we can express what these groups are with some other, more accurate way." Because obviously, it's related to diet and the nation-state is not directly responsible for the gut. And also, just ask them. For instance, in our roundtable conversation in the history of biology roundtable, we had a biologist respond to our papers and had some conversations with him.

**Tuttle:** Part of that would be the educational system too. It would be nice if all universities had—and of course, ours is not perfect—a kind of CORE, two years of being exposed to all of the humanities, social sciences, the importance of history. And then should they choose to become a biologist, they could ask questions of those biology teachers and hopefully be treated nicely by those biology teachers.

**Thomas:** Do you have an idea?

**Question (response):** I have a frustration.

**Nyhart:** I have a book! It's coming out in March from the University of Chicago Press that I co-edited with a biologist, which brings together historians, philosophers, and biologists to talk about the issue of biological individuality. We were very careful about picking people whom we considered to be somewhat amphibious, who already had shown, in some aspect of their writing or in their work, that they would be willing to talk across these fields. And we were, my co-editor and I, extremely heavy-handed about making sure that everybody's terms, everybody's writing was at least *legible* to everybody else, which was a lot of work.

**Tuttle:** Did you comment on each other's papers?

**Nyhart:** Well, no, we had two workshops and then we had a commentary by a biologist, a philosopher, and a historian on all ten papers.

**Question:** Professor Tuttle, you have mentioned that the tragedy of our species is that we don't learn from history. And then I believe it might have been Professor Harper who said something about biological determinism, so I was wondering if you think that there's a sort of fate that our species is tied to, that is inescapable, and if not, how do we become agents of our destiny as a species?

**Tuttle:** Well, there are people who are very selfish and who think they can cheat on history, and they can find other like people and form political groups and get power. And I don't know if they care how long they last or not; there are certainly cases right now of people who just don't care. They're going to get theirs now, while they can, and they might have some ideal they're trying to leave behind. So, again, people are irrational. It's sad. Nonetheless, I'm very optimistic about human capacity, even ape capacity. How do you get it? Mobilize. Whatever field you go into—look really deeply into the history and the different perspectives.

**Harper:** I think it's a great question, and maybe one that a philosopher's more equipped than I am to answer. But the way or the piece that I would want to add as a historian who thinks about the different ways human beings have experienced life and death, is that humans obviously have extraordinary capacities in the kind of cognition and culture that we have, but also the real kinds of material freedom. And self-determination that humans have is subject to different constraints and different ways over history. That's a historical question, and so just to go back to what I was talking about earlier, people who live in societies with life expectancies in the early twenties have very different kinds of freedom and different kinds of constraints than modern persons do. I think that there's something liberating, something very humanistic about understanding as well as we can the kinds of constraints that we have by being bodies that are subject to invasion, infection, and the different ways that members of our species have experienced that over time.

**Question:** You talked about biologists and you brought up this example of looking at the microbiome and broader biol-

ogy, but what about biology involving biologists on the scale of the CRISPR discovery, where the labs they're working in are mechanistic and, rather than studying populations, what they're studying are proteins and mechanisms of proteins? Can they similarly be involved or should they similarly be involved in the making of history?

**Nyhart:** They are! They're already doing it!

**Tuttle:** They're in the news.

**Nyhart:** And they're also writing a history! I mean, that's the thing. The history that I mentioned is by Eric Lander, who's the head of the Broad Institute. Biologists write history all the time. In fact, anyone who ever writes a grant proposal writes history, and usually the history goes like this: there were these ten things that all led to me, and my work is going to lead to the future. We all learn how to write like that when we write grant proposals. That's always writing a kind of history. When historians get at that history, then they have to kind of deconstruct it or compare it and say, "Well look, this person thinks all of these things led to him and his future, and all of these people say this story led to her and her future." And who gets the patent actually may depend on who writes the more persuasive history. So, I don't think that it is wrong to say that those mechanistic biologists are *already* writing history. I think that the effort comes in getting them to be more aware that there are also other kinds of history that they should be paying attention to.

**Question:** Professor Lyon touched on this already, but initially, from an outside perspective, it seems that this approach to history errs more on the side of social science as opposed to the humanistic approach to history, and I was wondering if you could talk briefly about pushback you might have received from traditional historians to these approaches?

**Radin:** I don't know about pushback, but I was told that I shouldn't write a history of the archive. And my sense of that was that to certain historians it was unseemly, or worse—banal—like looking at the plumbing or something, and so that wasn't the "real history." And so, I said, "Too late!" But I think in response to some of the questions—I wanted to touch back on the question of how you talk to biologists, or what you can talk to them about—I know that one of the real frustrations, and I don't know if this is yours, is that historians and particularly social scientists tend to write in a way that is alienating, and that people find inaccessible, and there are ways in which our own sub-communities require us to do that. One of the things that I discovered, the deeper I got into my research, is when I started to focus on the craftwork and the practices that people use, how they come to and find their research material or how they manage the freezer as a kind of instrument, it gave us a common language to talk about practice, to talk about what was happening. And I'm one of those people who did wind up spending time in the lab. I didn't think I was going to be doing some ethnographic work, but I realized I needed to understand how people were making knowledge in order to write historically about this particular project. One of the really exciting things that happened was just by spending time without really having a preconceived notion of what exactly would come out of it. People started asking me questions like, "What do you know about these materials? Where do they come from?" And it turned out that a lot of the graduate students who were doing work with these old samples had very little insight into their provenance or the reasons why they were collected in the first place. Some really remarkable kinds of conversations and insights happened by me just telling the history that I had learned about where and how these materials—and you can think about this in terms of big data or anything—came into the research context. And what was really interesting was to see how these graduate students, through our conversations, started to think differently about what questions they might ask, knowing: "these came from these regions and were collected for these purposes, and that is the motivation, so that shapes why we have this size of a sample as opposed to that size of a sample." Those kinds of conversations really inspired me to keep going. But I do think a challenge for *us* is to persuade people that this is history, too. This *is* history, and this *is* humanistic because science is done by humans. Science is done by people, and I think when scientists realize the humanistic heritage in their own practices is very powerful and fascinating.

**Tuttle:** The problem between the two areas is how you structure just *writing* about something. There's a lot of jargon that's specific to particular experience, so people aren't used to reading scientific papers. It sounds easy to read because they look shorter, but it's not always. And then you get a superfluity of words in the humanities and social sciences. Do they really tell you what they are going to write about? Do they have a thesis that makes sense? Do they, and are they hedging their bets here and there along the way?

**Nyhart:** I have to say, one of the most entertaining and instructive things about writing with a scientist is I feel like I'm constantly aerating his prose, and he's always saying, "You can turn this into three sentence, and it will be clearer. And cut out one of them." It's good that way.

**Question:** I have a question about the idea of progress. I think both history and biology share this sort of sense that we are moving forward. But I've also read in the past couple of years about health and the decline of health in America, at least in terms of nutrition and diseases that are caused by nutritional problems, and that for the first time we might be approaching a decline in life expectancy in America. I'm wondering what your thoughts are on this shared concept of progress between the two fields?

**Tuttle:** There is for middle-aged white males committing suicide and whatever...

**Thomas:** I think that's a very interesting question because it can be answered both biologically and as an intellectual history question, and I think that they actually are coming together in the same way at this moment. Many people are arguing now that history, that our sense of history as this grand narrative of progress, has come to a grinding halt, and that we are now mired in a kind of presentism where we can no longer imagine the future, to use your word there. And then, I think what the biological world is telling us, what this concept of the Anthropocene is telling us, is that those notions of probability, that someone like Jean Bodin was interested in, as being a way of going forward, because you can predict how the world might respond to us, can no longer be relied upon because of tipping points and sudden changes in the climate or productivity of soil or disease, or all those other things. And so, the notion that we can tell—progress is about a narrative, whether it's in biology or in history—and that now we may no longer be able to tell the stories has become, I think, a really important node of conversation. There's a book just out by Amitav Ghosh, the novelist, called *The Great Derangement: Climate Change and the Unthinkable* (2016), and this is a novel, but he's talking about the limits of representation at this moment—that our modes of representation have been based on progress, as you suggest—but now they may no longer serve us.

**Tuttle:** Who's to benefit from the progress in medicine and nutritional science, etc.? These are problems, certainly for humanists, for social scientists and politicians—kind, gentle politicians, and whatever—to claim to resolve.

**Harper:** I think with appropriate humility you can talk about something like biological well-being, and there has been some progress in some parts of the world at certain places for various reasons. But I'll just quickly say that one of the categories that I used, emerging infectious disease, didn't exist as an idea in 1980, but by 1990 it existed because people realized, scientists realized: oh crap, we got smallpox, we got polio, we got TB under control, and it turns out, first of all, those weren't as under control (except for smallpox) as we thought. But also that AIDS and other new diseases were emerging or reemerging. And so, that's maybe an example of hubris about scientific progress that took a step backward, or at least toward modesty—toward understanding the complexity of the ecology of microbes in our world.

**Tuttle:** As long as you have a monospecies—for instance, in if one plants the same kind of tree along the parkways and maybe even in the lawns, some hordes of bugs might invade and harvest it. We're similarly vulnerable. We're the victim of microbes. When you get it in heavy populations of people, or sometimes an accidental introduction in a smaller population, it can just wreak havoc. There is progress now, internationally, to try to stop these with preventative medicine, if you will, which I think is a progressive thing.

**Question:** Several people have mentioned interacting with either historians or scientists, but have you seen any obstacles from outside academia? One of you mentioned Northeastern Asia; are there governments that don't want to give you access to data or other things or don't like the direction that your work is going?

**Tuttle:** I wouldn't try to study hunger in North Korea. And people want to guard their own scientists and their own resources.

**Thomas:** You're asking about government relations?

**Question (restated):** Not necessarily government, but of people outside of academia. How do they react to your work? Are there people who don't like it?

**Thomas:** A few weeks ago, I was invited over by the South Korean government to consult on issues of climate change, and it was a very interesting moment for me because, obviously, on the one hand, you're in the role of a guest and they're treating you like a princess, and you get to fly business class—which, I don't know about you guys, but that's not usually how I fly! And on the other hand, I want to say to them: "What you've proposed for COP21 is absolutely unacceptable." What they decided to do is that their commitment to fighting climate change is to take a notion of business as usual. Of course, as they say, it's very, very hot, and they're proposing to cut business as usual. This means they're only going to emit 150 million more tons of carbon dioxide, which is not actually a decline in carbon dioxide. So, I didn't get *pushback* in the sense that I was certainly treated very well, but I got very politely-expressed disagreement over French dinners and elaborate banquets and other things like that. It's very interesting to try to engage with the people who are actually on the front lines of these political negotiations and to try to be effective and understand the fact that they are balancing factors that go beyond simply the knowledge that I have. You know, they've obviously got domestic considerations that they're catering to.

**Tuttle:** So, did they just want to cite you on the side of maintaining the status quo?

**Thomas:** I think there were people in the government who wanted me to say the things they couldn't say, but very marvelously, there's a happy ending to this. I spoke to the group of younger people who were training to be the diplomats for South Korea, and they're crème-de-la-crème, they're extraordinary—in their mid-twenties, very well-educated and well-informed, more than half women. They had no question that this wasn't the central issue; one of them immediately raised her hand and said, "Don't you think it's absolutely fabulous that our population is now declining in South Korea"—which is of course not their government's position—"because now we can become a model for the way the world needs to

go?" I think it was very useful for me to say, "Yes, that's a very good way of looking at it." I think we can speak outside of academia, and it does require a different idiom in terms of *how* we speak.

**Lyon:** I think that's a wonderful way to end. Just to quickly wrap up, there's one thing that stood out to me, as I sort of commented on running through that list of fields. Personally, as another faculty member, I was in awe of the range of knowledge that we saw on display here, trying to think about how one even goes about beginning to explore so many different fields. And Kyle, you made that wonderful point of how simply it can start, by asking a medical historian, "How do you think those Romans died?" That one simple question. That's my takeaway from this: that as extraordinary as this range of knowledge is, you have to start by asking someone in a different field a simple question, and from there, that takes you to new places. So, let us thank our five panelists!